
The Pharmaceutical Society of Great Britain
HABENDA RATIO VALETUDINIS

THE

CHEMICAL NEWS

AND

JOURNAL OF PHYSICAL SCIENCE.

WITH WHICH IS INCORPORATED THE "CHEMICAL GAZETTE."

A Journal of Practical Chemistry

IN ALL ITS APPLICATIONS TO

PHARMACY, ARTS, AND MANUFACTURES.

EDITED BY

WILLIAM CROOKES, F.R.S., &c.

VOLUME XLIII.—1881.

LONDON:
PUBLISHED AT THE OFFICE, BOY COURT, LUDGATE HILL, E.C.
AND SOLD BY ALL BOOKSELLERS.

MDCCCLXXXI.

8317

LONDON:
PRINTED BY EDWIN JOHN DAVEY,
BOY COURT, LUDGATE HILL, E.C.

CANCELL

THE

CHEMICAL NEWS

AND

JOURNAL OF PHYSICAL SCIENCE

Edited by Wm. Crookes, F.R.S.] (WITH WHICH IS INCORPORATED THE "CHEMICAL GAZETTE") [Established Thirty-Eight Years.

Vol. 43.—No. 1102.] Copyright reserved. Friday, January 7, 1881. Registered as a Newspaper. [Price, 8d. Post Free, 8½d.

INDEX NUMBER,

CONTAINING

TITLE-PAGE, INDEX, &c., TO VOLUME XLII.

CONTENTS.

CAPPER PASS AND SON, BRISTOL,

ARE BUYERS OF

LEAD ASHES, SULPHATE OF LEAD,
LEAD SLAGS, ANTIMONIAL LEAD,
COPPER MATTE, TIN ASHES, &c.,
and DROSS or ORES containing
COPPER, LEAD, AND ANTIMONY.

An Analytical Chemist, with first class references, desires an Engagement as Chemist, in works or otherwise. No objection to go abroad.—Adress, H. H., Chemical News Office, Boy Court, Ludgate Hill, London, E.C.

Advertiser, aged 44, seeks a Re-engagement in a Chemical Works as Manager, or Under-Manager and Analytical Chemist. Reference to present employers.—Address, H. C., Chemical News Office, Boy Court, Ludgate Hill, London, E.C.

TO INVENTORS.

A Gentleman from the States, having large Chemical Works, would like to make arrangements for a new article or a new process for manufacturing chemicals for the States.—Address, with full particulars, to J. D., care of Mr. A. Browne, 5, Southampton Buildings.

Metallurgical Engineer, shortly at liberty, seeks Re-engagement as Manager of Smelting Works. Educated at Freiberg. Experienced in planning and erecting metallurgical plant, specially lead smelting and desilverising, and in general and technical management. Practised Chemist and Assayer. At present Assistant Manager of one of largest Lead and Silver Works in Europe. Highest Testimonials and references.—Address, G. B. W., care of Messrs. G. Street and Co., 30, Cornhill E.C.

BRADY & MARTIN,
NEWCASTLE-ON-TYNE,

Will, on application, forward Catalogues of Chemical and Physical Apparatus, Pure Chemicals, Special Reagent Bottles with Embossed Labels, Nitrometer, &c., &c.

GRIFFIN'S
CHEMICAL HANDICRAFT.
SECOND EDITION.
Price 4s. 7d. post free.

A CATALOGUE OF CHEMICAL APPARATUS:
ILLUSTRATED, CLASSIFIED, DESCRIPTIVE.
Demy 8vo., 480 pp., Illustrated with 1600 Woodcuts.
Most complete and cheapest List of Apparatus.

JOHN J. GRIFFIN and SONS, 22, Garrick Street, London, W.C.

THE JOURNAL OF SCIENCE
for JANUARY (Price 1s. 6d.), includes—

Life and its Basis. By J. H. Barker, M.A.
Atlantis and Lemuria: The Distribution of Land and Sea.
Industrial Training. By An Old Technologist.
Comparative Psychology.
The Materialistic Origin of the Sexes. By Andrew Dewar, Author of "Origin of Creation."

Analyses of Books. Correspondence. Notes.

London: 3, Horse-Shoe Court, Ludgate Hill.

ROYAL AGRICULTURAL COLLEGE,
CIRENCESTER.

PROFESSORSHIP OF GENERAL AND AGRICULTURAL CHEMISTRY.

This Chair will be vacant in May. Gentlemen duly qualified especially in Agricultural Chemistry and Chemico-Agricultural Work, are invited to become Candidates. Salary £400 with one Assistant, or £300 with two, without Board and Residence. Excellent Laboratory Facilities for Private Work. The new Professor to enter on duties May 30. Testimonials, &c., to be forwarded to the Principal on or before Satuiday, March 5th, 1881.

A Chemist, with many years' experience in Chemical Works, desires an Engagement as Manager or Chemist. Able to design and erect plant. Good references.—Address, L., Chemical News Office, Boy Court, Ludgate Hill, London, E.C.

Wanted, for a Chemical Laboratory in the City, Assistant well up in Commercial Analyses. Salary to begin £1 weekly, increasing if found suitable.—Address, Y., 4383, Deacon's Advertising Offices, 154, Leadenhall Street, E.C.

Wanted for America—A thoroughly capable, Practical and Scientific Chemist, competent to make Ammoniacal Products from Gas water. Also one to make Sulphate of Copper and Acetic Acid by the latest and best processes.—Address, Box, 2660, New York P.O., U.S.A.

BERNERS COLLEGE of CHEMISTRY.

Instruction and preparation in CHEMISTRY and the EXPERIMENTAL SCIENCES under tbe direction of Professor E. V. GARDNER, F.A.S., M.S.A.

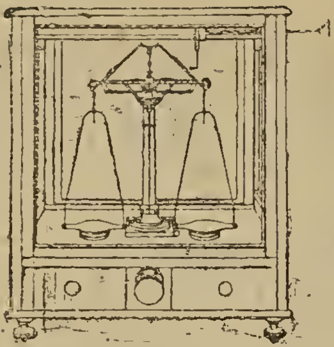
The Class Rooms are open from 11 to 5 a.m. and from 7 to 10 p.m daily.

Especial facilities or persons preparing for Government and other examinations.

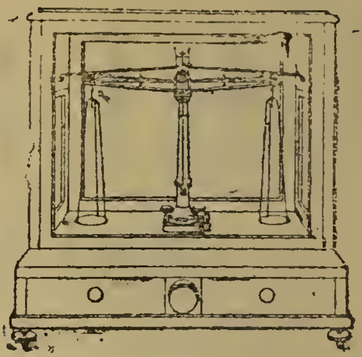
Private Pupils will find every convenience.

Analyses, Assays, and Practical Investigations connected with Patents, &c., conducted.

Prospectuses and full particulars on application to Prof Gardne at Berners Col



L. OERTLING,
TURNMILL STREET
(OPPOSITE FARRINGDON STREET STATION.)
MANUFACTURER OF
CHEMICAL, ASSAY, & BULLION BALANCES.
Maker to the Bank of England, Assay Office of the Royal Mint, &c., &c.
By Appointment.



COU MEDAL, 1851. FIRST CLASS MEDAL, 1854 and 1862.

UNIVERSAL
FILTER-PRESSES WITH FRAMES,
THE BEST FILTER-PRESS ON THE MARKET,
OF
WEGELIN & HÜBNER, HALLE ON SAALE, GERMANY,
ENGINEERS AND IRONFOUNDERS,

Made in Wood, Iron, Bronze, or Lead, for the Filtration or Separation of Liquids from Solid Matters, with or without attachment, for the perfect washing of the latter.

MORE THAN 1000 PRESSES SOLD FOR THE MANUFACTURE OF—

Alum, Aniline, Alizarine, Anthracene, Barytes, Blanc-fix, Berlin Blue, Beer Wort, White Lead, Carmine, Sulphate of Quinine, Carbonate of Magnesia, Caustic Soda, Ceresine, Chrome Colours, Tartaric Acid, Cream of Tartar, Gelatine, Glue, Glycerine, Graphite, Hydrated Alumina, Oxide of Nickel, Paraffine, Prussiate of Potash, Pyroligneous Acid, Printing Ink, Phosphoric Acid, Salt Brine, Salicylic Acid, Silicate Paints, Starch, Porcelain, China-Clay, Glucose, Stearine, Ultramarine, Yeast, Zinc-white, Sugar, and Sugar Refineries pp.

Experiments with Substances to be Filtered are carefully made in our Testing Shop.

Price and Reference Lists will be sent on application.

MAWSON & SWAN,
LABORATORY OUTFITTERS,
IMPORTERS & MAKERS OF PHILOSOPHICAL INSTRUMENTS
CHEMICAL, ELECTRICAL, AND OTHER APPARATUS.

MAWSON & SWAN have an extensive assortment of all kinds of Chemical and Scientific Apparatus, Pure Chemicals, and Reagents.

Sole Agents for the sale of Bunge's *Celebrated Balances and Weights of Precision.*

13 & 15 MOSLEY STREET
NEWCASTLE-ON-TYNE,

TOWNSON & MERCER,
89, Bishopsgate Street Within,
LONDON.
Wholesale and Export Dealers and Manufacturers of
CHEMICAL & SCIENTIFIC APPARATUS,
PURE CHEMICALS, &c.,
For Analysis and the general Laboratory Use of Manufacturers and Professors of Universities, Schools, Mines, &c.

Now ready,
TOWNSON & MERCER'S COMPLETE CATALOGUE of Chemical and Scientific Instruments, Pure Chemicals &c. Demy 8vo. Illustrated with upwards of 800 Woodcuts. Price 2s. 6d., post free.

Silicates of Soda and Potash in the state of Soluble Glass, or in CONCENTRATED SOLUTION of first quality, suited for the Manufacture of Soap and other purposes, supplied on best terms by W GOSSAGE and Sons, Soap Works, Widnes, Lancashire.
London Agents, COSTE and Co., 19 and 20, Water Lane, Tower Street, E.C., who hold stock ready for delivery.

SULPHUROUS ACID.
SULPHITES AND BISULPHITES OF
SODA AND LIME.

MAKERS:
A. BOAKE & CO.,
STRATFORD, LONDON, E.

SUPPLEMENT TO THE CHEMICAL NEWS

CONTAINING

INDEX AND TITLE-PAGE TO VOLUME XLII.

KÖRTING BROTHERS,

ENGINEERS,

17, LANCASTER AVENUE, FENNEL STREET,

MANCHESTER.


Air Compresser.

PATENT STEAM-JET AIR COMPRESSERS for oxidising caustic alkalies and agitating liquids.

PATENT STEAM-JET EJECTORS to give a vacuum up to 27 feet of water.

SUPPLIED TO:—

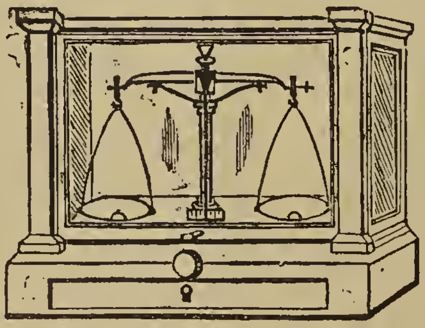
The Blaydon Manure and Alkali Co., Lim.
Messrs. Brooke, Simpson, and Spiller, Hackney Wick.
Messrs. Burt, Boulton, and Haywood, Silvertown.
,, Chance, Bros., Oldbury.
,, N. and J. H. Fenner, London.
The Ford Works Co., Lim., Sunderland.
Messrs. Gaskell, Deacon, and Co., Widnes.
,, Wm. Gossage and Sons, Widnes.
,, Grimble and Co., London.
,, Hardman and Co., Manchester.
,, Holmes and Partner, Warrington.
,, Jno. Hutchinson and Co., Widnes.
The Jarrow Chemical Company, Gateshead.
Messrs. D. Martineau and Sons, London.
,, Jas. Muspratt and Sons, Widnes.
The North British Chemical Co., Dalmuir.
The Patent Sulphate Copper Company Macclesfield.
Messrs. Jno. Riley and Sons, Hapton.
,, Roberts, Dale, and Co., Manchester.
,, Robinson, Pollard, and Co., Portsea.
,, Stainsby and Lyon, Knottingley.
,, Taylor, Greenall, and Kidd, Widnes.
,, C. Tennant and Co., Glasgow.
,, Wells and Galloway, Lim., Widnes.
,, Rd. Wheen and Sons, London.
The Widnes Alkali Co., Widnes.

Circulars and Testimonials on Application.

BECKER & SONS,

MANUFACTURERS OF
CHEMICAL AND GOLD ASSAY BALANCES
AND OTHER
SCALES AND WEIGHTS.

ROTTERDAM.



NEW YORK.

BECKER'S STUDENT'S BALANCE, in polished mahogany glass case, sliding front, counterpoised, to carry 30 grammes in each pan and turn to ½ milligramme, nickel plated pans £2 10
Ditto, ditto, in mahogany glass case, polished black.. .. .. £2 13

Sole Agents for England, Ireland, and Wales:—

TOWNSON & MERCER.

Becker's Complete Lists forwarded by post on receipt of 1*d.* stamp or free on application.

SOUTH LONDON CENTRAL PUBLIC LABORATORY.

A Department has been opened for the Private Instruction of Gentlemen in Practical Chemistry as applied to any Special Industries or Commercial Products they may wish to study. For Fees, &c., apply to W. Baxter, Secretary, Central Public Laboratory, Kennington Cross, S.E.

BISULPHIDE OF CARBON
PROTOSULPHAT
RED OXIDE
OXYCHLORIDE
Sulphocyanide,
And every other Mercurial Preparation.

BISULPHITE OF LIME, TETRACHLORIDE OF CARBON.
Oxysulphuret of Antimony, Glacial Acetic Acid,

Liquor Ammoniæ,
Sulphide of Iron,
Pure Acids,
Chloride of Sulphur,
Acetone,
Chloroform,
Aldehyde,
Chlorate Baryta,
Arsenic Acids,
Fruit Essences for Confectionery & Liqueurs,
Perchloride of Iron,
Sulphite and Hyposulphite of Soda,
Phosphates of Soda and Ammonia,
Ethers,
Bromides,
Iodides,
Scale and Granular Preparations,
Sulphide of Sodium.

ALSO,
Pure Photographic Chemicals of every kind.

MANUFACTURED BY
WILLIAM BAILEY & SON,
HORSELEY FIELDS CHEMICAL WORKS,
WOLVERHAMPTON.

SILICATE OF SODA, Solid and in Solutions of Various Degrees of Concentration: the finest quality obtainable, and especially adapted for the use of Soap Makers and other Consumers.—JOSEPH CROSFIELD and SONS, Soap Makers, &c., Warrington.
London Agent—H. B. CLARKE, Great Tower Street, E.C.

ACTIEN-GESELLSCHAFT
FÜR
ANILIN-FABRIKATION,
BERLIN,

Manufacturers of Aniline Colours for Dyeing and Printing on Silk, Wool, Cotton, Leather, &c.

WORKS—Rummelsburg and Wiesenufer, near Berlin.
OFFICES—Treptower Brücke, S.O.
TELEGRAM—"Anilin," Berlin.

MANUFACTURERS OF

RUBINES,	Engl. Patent, No. 243 (1878)	ACID YELLOW	Germ. Patent, No. 4186
ACID-RUBINE	,, ,, 2828 (1879)	MALACHITE GREENS,	Engl. Patent, No. 828 (1878)
PONCEAUS	,, ,, 1715 (1878)	ACID MALACHITE GREEN	,, ,, 4406 (1878)
BORDEAUX	,, ,, 1715 (1878)	BENZYLE BLUES	
PHOSPHINES		WATER BLUES	
MANDARINES			

Eosines
Rosaniline Base
Safranines
Coccines

Nigrosine
Coralline
Aurine
Martius Yellow
Berlin Brown
Regina Violet
Methyle Violets

Cotton Scarlets
Aurantia
Picric Acid
Methyl Orange

Hofmann Violet
Marine Blue
Paper Blue
Mode Brown
Nacarate
Bavarian Blues
Night Blue

Bismarck Brown
Aniline Gray
Methyle Greens
Spirit Blue

Humboldt Blue
Alkali (Nicholson) Blue
Guernsey Blue
Gentiana and Royal Blue and Gray Pastes
China Blue
Indigo Blue

ANILINE OILS
ANILINE SALTS IN CAKES AND CRYSTALS
MIRBANE OIL
METHYLE ANILINE

Samples and Prices on Application. *Special Terms to Merchants and Shippers.*

ALL GENUINE PACKAGES ARE PROTECTED BY TRADE-MARK.

⁂ Our Rubine (Magenta), and all Colours derived therefrom, are manufactured without employing Arsenic Acid.

SPECIALITIES.

MANGANESE—Finest Crystallised, Lump, Ground, and Granulated of every quality, and PREPARED for *Chlorine, Glass, Steel, Ferro-Manganese Pottery, Battery*, and EVERY PURPOSE.

BAUXITE—(Hydrate of Alumina) Of high percentage of Alumina and almost free from Iron. The CHEAPEST, BEST, and MOST PROFITABLE article from which to produce ALUM, ALUM CAKE, and SULPHATE OF ALUMINA, &c. [BRAND, "IRISH HILL BAUXITE."]

FLUOR-SPAR—Of the Very Finest Quality for Acid, Soda, Glass Flux, and all purposes.

BARYTES—(Carbonate and Sulphate.) Crystallised, Selected Lump and Ground for all uses.

CRYOLITE—Magnesite, Felspar, Arsenic, Phosphates, French Chalk, Strontia, Wolfram, Chrome, Terra Alba, Rotten Stone, China Clay, Umbers Ochres, Antimony, Calamine, Emery Stone all Oxides, and all

FULLER'S EARTH—Of superior quality, and entirely free from grit. [BRAND, "EMERALD."]

MINERALS, CHEMICALS, AND COLOURS.

GEO. G. BLACKWELL,

MINE PROPRIETOR,

Manganese and Mineral Works, Grinding Mills, and Ore Yards, GARSTON.

OFFICES—26 CHAPEL STREET LIVERPOOL.

TETRACHLORIDE OF CARBON.
BISULPHIDE OF CARBON.
CHLORIDE OF SULPHUR.

JESSE FISHER & SON,
Phœnix Chemical Works Ironbridge.

ESTABLISHED 1798.

ROBERT DAGLISH & CO.,
ENGINEERS, BOILER AND BRIDGE MAKERS, MILLWRIGHTS,
BRASS AND IRON FOUNDERS.

Manufacturers of every description of Condensing, or High-pressure Blowing, Pumping, Rolling, Winding, and Patent Steam-engines, of any required power, for Irrigating, Draining, Mining, Rolling Mills, or Water Works purposes, and Manufacturers of every description of Chemical, Colliery, Copper Ore, Gold Mining, Glass, and Rock-salt Machinery.

Black-ash Revolving Furnaces of the Most Approved Type.

Bessemer Steel-Rail Plant.

Compressing-Engines for Collieries, Iron Works, and Weldon's Patent Bleaching-Powder Process.

Caustic, Chlorate, Decomposing, Nitre, Nitro-Glycerine, Iodine Potash, Sulphur, Acid, and Oxalic Pans.

Gas Producers Patent for Heating and other Purposes.

Pyrites Burners for Irish, Norwegian, and Spanish Ores of Improved Construction.

Patent Rousing Machinery for Brewers.

Retorts, Acid, Gas, Iodine, Nitric, Nitre, Nitro-Glycerine and Vitriol Refining.

Steam Superheaters improved for Oil, Tar, and Resin Refining.

Steam Sulphur Melter.

Stills for Oil, Resin, and Tar.

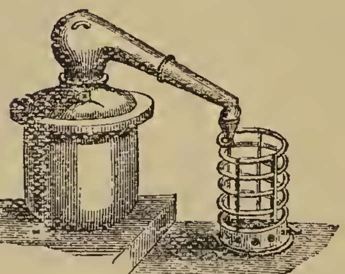
Wheels, Bevel, Mitre, and Spur Moulded on the Shortest Notice by Patent Machinery.

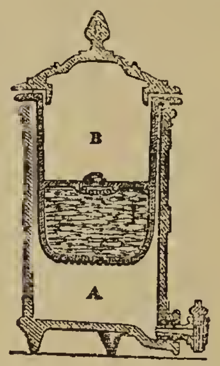
Makers of Mactear's Patent Carbonating Furnace, Jones and Walsh's Patent Sulphate of Soda Furnace, Parnell and Simpson's Patent Causticiser, and Kynaston's Patent Alum Plan

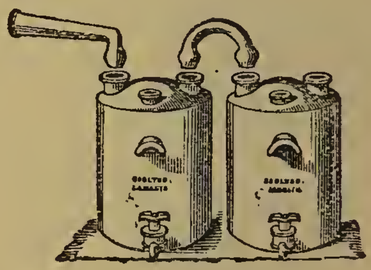
Lists sent on Application.

Photographs, Plans, and other information supplied on receipt of Order.

ST HELEN'S ENGINE, BOILER, AND BRIDGE WORKS AND FOUNDRY,
LANCASHIRE.







London: Printed and Published for the Proprietor by Edwin John Davey, at the Office, Boy Court, Ludgate Hill, E.C.
January 7, 1881.

THE

CHEMICAL NEWS

AND

JOURNAL OF PHYSICAL SCIENCE

Edited by Wm. Crookes, F.R.S. (WITH WHICH IS INCORPORATED THE "CHEMICAL GAZETTE") *Established Thirty-Eight Years.*

Vol. 43.—No. 1103. *Copyright reserved.* Friday, January 14, 1881. *Registered as a Newspaper.* PRICE, 4*d.* POST FREE, 4½*d.*

CONTENTS.

ARTICLES:— PAGE

CAPPER PASS AND SON, BRISTOL,

ARE BUYERS OF

LEAD ASHES, SULPHATE OF LEAD,
LEAD SLAGS, ANTIMONIAL LEAD,
COPPER MATTE, TIN ASHES, &c.,
and DROSS or ORES containing
COPPER, LEAD, AND ANTIMONY.

A Chemist, with many years' experience in Chemical Works, desires an Engagement as Manager or Chemist. Able to design and erect plant. Good references.—Address, L., CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.

An Analytical Chemist, with first class references, desires an Engagement as Chemist, in works or otherwise. No objection to go abroad.—Adress, H. H., CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.

Advertiser, aged 44, seeks a Re-engagement in a Chemical Works as Manager, or Under-Manager and Analytical Chemist. Reference to present employers.—Address, H. C., CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.

A Gentleman, F.C.S., aged 21, is desirous of obtaining an Appointment, either at home or the Continent, with an Analytical Chemist. Four years' practical experience. References from eminent chemists. Well up in general analytical practice.—F.C.S., Oxford Villa, Uxbridge.

An Efficient Chemist desires an Engagement. First rate Analyst, and capable of controlling Works and Workmen.—Address, Q. 24, at C. H. May and Co.'s General Advertising Offices, 78, Gracechurch Street, E.C.

A Young Chemist, who has studied with Prof. Fresenius, and is since August, 1879, assistant in his private aboratory, is open for engagement.—Apply to A. W. F., CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.

Wanted for America—A thoroughly capable, Practical and Scientific Chemist, competent to make Ammoniacal Products from Gas water. Also one to make Sulphate of Copper and Acetic Acid by the latest and best processes.—Address, Box, 2660, New York P.O., U.S.A.

BRADY & MARTIN,
NEWCASTLE-ON-TYNE,

Will, on application, forward Catalogues of Chemical and Physical Apparatus, Pure Chemicals, Special Reagent Bottles with Embossed Labels, Nitrometer, &c., &c.

GRIFFIN'S
CHEMICAL HANDICRAFT.
SECOND EDITION.
Price 4s. 7d. post free.

A CATALOGUE OF CHEMICAL APPARATUS:
ILLUSTRATED, CLASSIFIED, DESCRIPTIVE.
Demy 8vo., 480 pp., Illustrated with 1600 Woodcuts.
Most complete and cheapest List of Apparatus.

JOHN J. GRIFFIN and SONS, 22, Garrick Street, London, W.C.

ROYAL AGRICULTURAL COLLEGE,
CIRENCESTER.

PROFESSORSHIP OF GENERAL AND AGRICULTURAL CHEMISTRY.

This Chair will be vacant in May. Gentlemen duly qualified especially in Agricultural Chemistry and Chemico-Agricultural Work, are invited to become Candidates. Salary £400 with one Assistant, or £300 with two, without Board and Residence. Excellent Laboratory Facilities for Private Work. The new Professor to enter on duties May 30. Testimonials, &c., to be forwarded to the Principal on or before Saturday, March 5th, 1881.

INSTITUTE OF CHEMISTRY.

An Examination in Practical Chemistry in connection with the Institute will be held on Monday, February 21st, 1881, and four following days. Examiner—Dr. W. R. Hodgkinson. Candidates are requested to communicate with the Secretary. Mr. Charles E. Groves, Somerset House Terrace, London, W.C.

THE BRITISH PHARMACEUTICAL CONFERENCE.
SECRETARY WANTED.

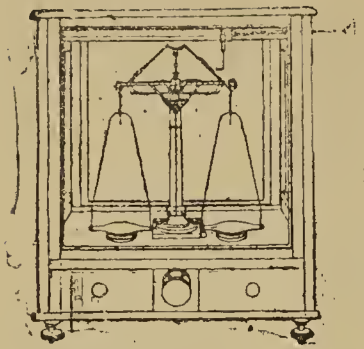
THE Executive Committee invite applications from gentlemen willing to act as SECRETARY. The duties will be to conduct the correspondence, collect subscriptions, keep the books, and carry on the general business of the Conference, under the direction of the Honorary Secretaries and Treasurer. The Secretary will also be required to assist in organising the Annual Meetings, and reside in London. Salary £100 per annum. Applications should be addressed without delay to the Hon. Secretaries, Brit. Pharm. Conference, at 17, Bloomsbury Square, London, W.C.

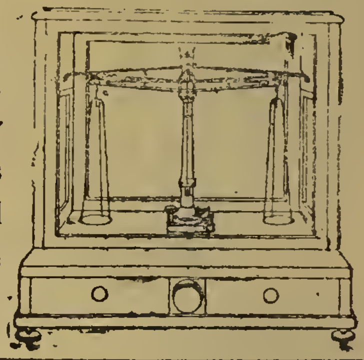
E. BADEN BENGER
MICHAEL CARTEIGHE } *Hon. Secs.*

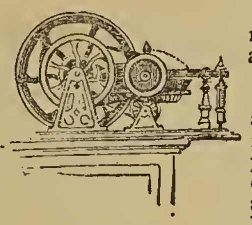
THE Principals of one of the finest Private Chemical Institutions in England desire to meet with a gentleman capable of introducing students and undertaking their supervision. The laboratories afford unusual advantages to students of Chemistry, Metallurgy, Pharmacy, &c. Liberal terms offered.—Address, Ph.D., Chemical News Office, Boy Court, Ludgate Hill, London, E.C.

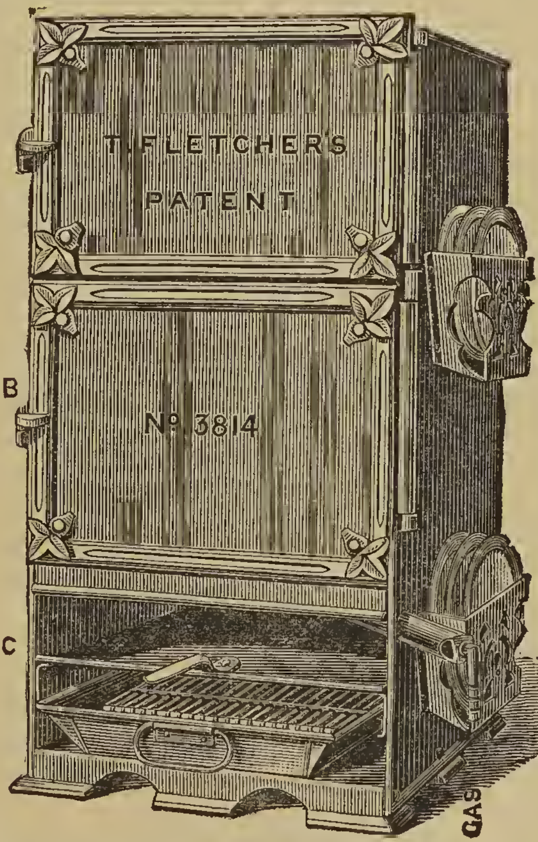
Wanted, a Foreman who understands the Manufacture of Lump Alum.—F. G., care of B. Wheeler's, Manchester.

Chemist, Ph.D. (Prussia), (28), of thorough scientific training, accurate Analyst, also well versed in Organic Chemistry and Original Research, of several years' varied experience, at last Demonstrator to a well-famed Educational Institution of England, seeks Engagement, here or abroad, immediately or later. Excellent testimonials and recommendations.—Address, E. S., 36, Bellevue Crescent, Clifton, Bristol.








T. FLETCHER'S
PATENT
B
No 3814
C
GAS

London: Printed and Published for the Proprietor by EDWIN JOHN DAVEY, at the Office, Boy Court, Ludgate Hi E.C.
January 14, 1881.

THE CHEMICAL NEWS AND JOURNAL OF PHYSICAL SCIENCE

(WITH WHICH IS INCORPORATED THE "CHEMICAL GAZETTE")

Edited by Wm. Crookes, F.R.S.

Established Thirty-Eight Years.

Vol. 43.—No. 1104. *Copyright reserved.* Friday, January 21, 1881. *Registered as a Newspaper.* PRICE, 4*d.* POST FREE, 4½*d.*

CONTENTS.

ARTICLES :— PAGE

CAPPER PASS AND SON, BRISTOL,
ARE BUYERS OF
LEAD ASHES, SULPHATE OF LEAD,
LEAD SLAGS, ANTIMONIAL LEAD,
COPPER MATTE, TIN ASHES, &c.,
and DROSS or ORES containing
COPPER, LEAD, AND ANTIMONY.

Advertiser, aged 44, seeks a Re-engagement in a Chemical Works as Manager, or Under-Manager and Analytical Chemist. Reference to present employers.—Address, H. C., CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.

A Young Chemist, who has studied with Prof. Fresenius, and is since August, 1879, assistant in his private laboratory, is open for engagement.—Apply to A. W. F., CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.

An Analytical Chemist is desirous of obtaining for a Young Man, who has been his Assistant for four years, an independent position as Chemist in Metal or other Works, or a situation in a good laboratory in general practice. Most satisfactory testimony can be borne as to character and ability.—Address, Mr. R. Routledge, F.C.S., North Eastern Railway, Greensfield, Gateshead-on-Tyne.

Metallurgical Engineer, shortly at liberty, seeks Re-engagement as Manager of Smelting Works. Educated at Freiburg. Experienced in planning and erecting metallurgical plant, especially lead smelting and desilverising, and in general and technical management. Practised Chemist and Assayer. At present Assistant Manager of one of largest Lead and Silver Works in Europe. Highest testimonials and references.—Address, G. B. W., care of Messrs. G. Street, and Co., 30, Cornhill, E.C.

INVESTMENT.
A few gentlemen, who are forming a Company for the Development and Exhibition of New Inventions in London, would be glad to secure additional co-operation.—Address, Marcus A. Glendinning, Esq., 76, Chancery Lane, London, W.C.

A Sound Company or Firm requiring first-class office accommodation in the City, may meet with the same, combined with professional assistance and commercial representation by an Experienced Engineer with a fair connection. Terms very moderate. Unexceptional references.—Address, X., care of Housekeeper, Palmerston Buildings, E.C.

BRADY & MARTIN,
NEWCASTLE-ON-TYNE,
Will, on application, forward Catalogues of Chemical and Physical Apparatus, Pure Chemicals, Special Reagent Bottles with Embossed Labels, Nitrometer, &c., &c.

GRIFFIN'S
CHEMICAL HANDICRAFT.
SECOND EDITION.
Price 4s. 7d. post free.

A CATALOGUE OF CHEMICAL APPARATUS:
ILLUSTRATED, CLASSIFIED, DESCRIPTIVE.
Demy 8vo., 480 pp., Illustrated with 1600 Woodcuts.
Most complete and cheapest List of Apparatus.

JOHN J. GRIFFIN and SONS, 22, Garrick Street, London, W.C.

THE JOURNAL OF SCIENCE
for JANUARY (Price 1s. 6d.), includes—
Life and its Basis. By J. H. Barker, M.A.
Atlantis and Lemuria: The Distribution of Land and Sea.
Industrial Training. By An Old Technologist.
Comparative Psychology.
The Materialistic Origin of the Sexes. By Andrew Dewar, Author of "Origin of Creation."
Analyses of Books. Correspondence. Notes.
London: 3, Horse-Shoe Court, Ludgate Hill.

This day is published, post 8vo., cloth, 5s.,
PROFESSOR FRANKLAND'S LECTURE NOTES FOR CHEMICAL STUDENTS. Third Edition. Organic Chemistry. Revised and brought up to date by Dr. F. R. Japp, M.A., F.I.C., Demonstrator in the Research Laboratory of the Royal College of Chemistry.
The Volume on Inorganic Chemistry, Sixth Thousand, 4s.
JOHN VAN VOORST, 1, Paternoster Row.

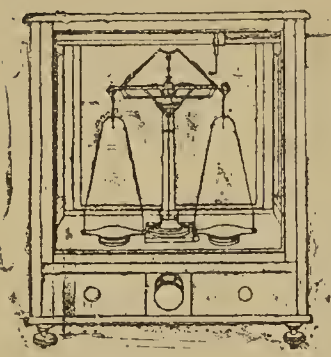
ROYAL AGRICULTURAL COLLEGE, CIRENCESTER.
PROFESSORSHIP OF GENERAL AND AGRICULTURAL CHEMISTRY.
This Chair will be vacant in May. Gentlemen duly qualified especially in Agricultural Chemistry and Chemico-Agricultural Work, are invited to become Candidates. Salary £400 with one Assistant, or £300 with two, without Board and Residence. Excellent Laboratory Facilities for Private Work. The new Professor to enter on duties May 30. Testimonials, &c., to be forwarded to the Principal on or before Saturday, March 5th, 1881.

THE Principals of one of the finest Private Chemical Institutions in England desire to meet with a gentleman capable of introducing students and undertaking their supervision. The laboratories afford unusual advantages to students of Chemistry, Metallurgy, Pharmacy, &c. Liberal terms offered.—Address, Ph.D., Chemical News Office, Boy Court, Ludgate Hill, London, E.C.

FOR SALE, Price £100.—A rapidly growing analytical practice in the West of England. To be sold because the owner is leaving England.—Apply by letter, G. W. R., 52, Drury Lane, London, W.C.

Manager wanted for a small Chemical Works. Must understand the manufacture of Logwood Extract and Chinese Blue. State salary required.—Address, J. F. J., CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.

Wanted for America—A thoroughly capable, Practical and Scientific Chemist, competent to make Ammoniacal Products from Gas water. Also one to make Sulphate of Copper and Acetic Acid by the latest and best processes.—Address, Box, 2660, New York P.O., U.S.A.



L. OERTLING,

TURNMILL STREET
(OPPOSITE FARRINGDON STREET STATION.)

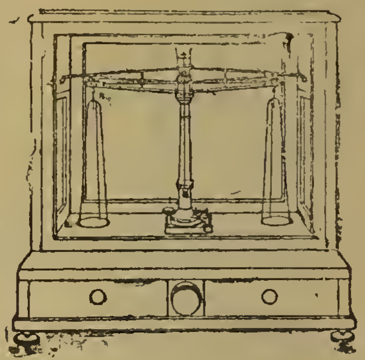
MANUFACTURER OF

CHEMICAL, ASSAY, & BULLION BALANCES.

Maker to the Bank of England, Assay Office of the Royal Mint, &c., &c.

By Appointment.

COUNCIL MEDAL, 1851. FIRST CLASS MEDAL, 1854 and 1862.



SOUTH LONDON SCHOOL OF PHARMACY.

Special advantages are offered to Private Students during the Vacation in every branch of Practical Chemistry, as applied to Manufactures, Agricultural and Commercial Products, Water, Gas, Food, &c.

For terms, personal or by letter, W. Baxter, Secretary, Central Public Laboratory, Kennington Cross, S.E.

ASBESTOS.

H. W. JOHN'S MANUFACTURING CO. have appointed WITTY and WYATT Sole European and Colonial Agents for their well known ASBESTOS Fire-proof Paints and other materials, which for twenty years have been largely used in the United States, South America, China, Japan, &c.

ASBESTOS RETORT CEMENT is Fire- and Acid-Proof; when subjected to intense heat will vitrify without shrinking, thus rendering it of great value in repairing retorts, pipes, and other chemical appliances.

WITTY AND WYATT, 9, Fenchurch Street, E.C
ASBESTOS WAREHOUSES, 1, Fenchurch Avenue.

MAWSON & SWAN,

LABORATORY OUTFITTERS,

IMPORTERS & MAKERS OF PHILOSOPHICAL INSTRUMENTS
CHEMICAL, ELECTRICAL, AND OTHER APPARATUS.

MAWSON & SWAN have an extensive assortment of all kinds of Chemical and Scientific Apparatus, Pure Chemicals, and Reagents.

Sole Agents for the sale of Bunge's *Celebrated Balances and Weights of Precision.*

13 & 15, MOSLEY STREET,
NEWCASTLE-ON-TYNE.

AMMONIACAL LIQUOR.

THE DIRECTORS OF THE BRISTOL UNITED GAS LIGHT COMPANY invite TENDERS for the PURCHASE of the AMMONIACAL LIQUOR made at all or either of their THREE STATIONS, situate respectively at AVON STREET, CANONS' MARSH, and STAPLETON ROAD in the Borough of Bristol, for a TERM of FIVE or SEVEN YEARS, commencing on 1st JULY, 1882.

The Annual Quantity of Liquor produced at present at the three Stations is about 2¼ millions of gallons.

Conditions of Contract and other particulars may be obtained of the SECRETARY, at the Office of the Company, Canon's Marsh, Bristol.

Tenders to be delivered on or before TUESDAY, 3rd day of May next, addressed to the Chairman of the Company, and marked "Tender for Ammoniacal Liquor."

The Directors do not bind themselves to accept the highest or any Tender.

HENRY H. TOWNSEND, Secretary.

Gas Offices, Canons' Marsh, Bristol,
8th January, 1881.

TOWNSON & MERCER,

89, Bishopsgate Street Within,
LONDON.

Wholesale and Export Dealers and Manufacturers of

CHEMICAL & SCIENTIFIC APPARATUS,
PURE CHEMICALS, &c.,

For Analysis and the general Laboratory Use of Manufacturers and Professors of Universities, Schools, Mines, &c.

Now ready,

TOWNSON & MERCER'S COMPLETE CATALOGUE of Chemical and Scientific Instruments, Pure Chemicals &c. Demy 8vo. Illustrated with upwards of 800 Woodcuts. Price 2s. 6d., post free.

MOTTERSHEAD & CO.,

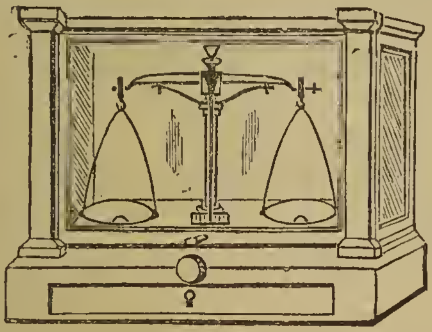
7, Exchange Street and 10, Half Moon Street,
MANCHESTER.

CHEMICAL & PHYSICAL APPARATUS,
BOTTLES, PURE CHEMICALS,
REAGENTS, STANDARD SOLUTIONS,
And Every Requirement for Works' or School Laboratories or Private Students.

Illustrated Price Lists on application.

Water-Glass, or Soluble Silicates of Soda and Potash, in large or small quantities, and either solid or in solution, at ROBERT RUMNEY'S Ardwick Chemical Works, Manchester.

Wanted, to Purchase Volumes 1, 3, 5, 6, and 7, of the 'Journal of the Chemical Society"; also Vol. 3 of the "Proceedings of the Royal Society."—Address, K. P. G., Chemical News Office, Boy Court, Ludgate Hill, London, E.C.

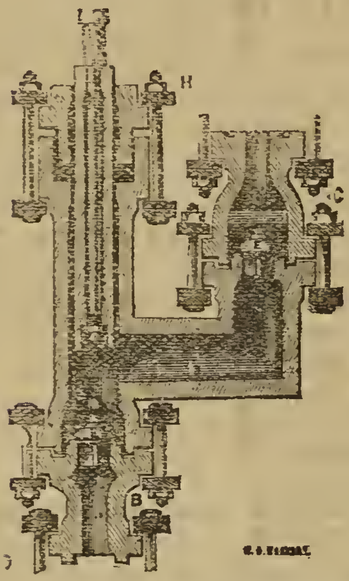

ROTTERDAM.
NEW YORK.

DOULTON & WATTS

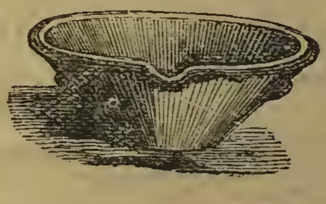
HIGH STREET, LAMBETH, LONDON, S.E.
MANUFACTURERS OF

STILLS, RETORTS, CONDENSING WORMS, WOLLF'S BOTTLES, ACID PUMPS, COCKS, PERCOLATORS, AIR-TIGHT JARS

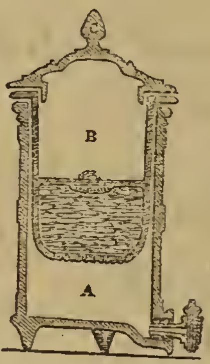
And every description of Stoneware for Chemical Purposes, warranted to resist the strongest acids.



PLUMBAGO CRUCIBLES AND OTHER FIRE-STANDING GOODS.



DOULTONS. MANGANOUS



CARBON FILTER.

(Dr. Bernays's Patent).

The Patent Manganous Carbon Filter combines important improvements in construction which have been effected by Messrs. Doulton & Co., in conjunction with a valuable discovery made by Dr Bernays, Professor of Chemistry at St. Thomas's Hospital; Public Analyst; Chemist to the Kent Water Works, &c., &c., &c.

NEW SHOW ROOMS, ALBERT EMBANKMENT, LAMBETH, S.E.
Depots :—Wood St., Birmingham; 100, Soho St., Liverpool; and 6, Rue de Paradis Poissonière, Paris.

WILLIAM AND WILLIAM T. FIELD,

MANUFACTURERS of the Celebrated STAFFORDSHIRE BLUE BRICKS, specially adapted for Chemical Plant, *i.e.*, Acid Towers, &c. Also all other kinds of Best Staffordshire Blue Bricks, Pavings, Plynths, Splays, Copings, &c. &c. Prices and samples on Application.

TESTIMONIAL

"We have used the Blue Staffordshire Brick or Sulphuric Acid Towers, &c., manufactured by Messrs. Field, for the last fifteen years during which time they have given great satisfaction. We recommend them to the Chemical Trade, believing there is nothing better in the market."—(Signed) WILLIAM HUNT and SONS, Lea Brook Alkali Works, near Wednesbury, Staffordshire, February, 1878.

TOLL END BRICK-WORKS,
TIPTON, STAFFORDSHIRE.

BISULPHIDE OF CARBON.

CHLORIDE OF SULPHUR.

GAS PURIFICATION & CHEMICAL CO., LIMITED,
161, 162, 163, Palmerston Buildings, London, E.C.

THOMAS ADKINS & CO.,
SMETHWICK,
NEAR BIRMINGHAM.

Manufacturers of Specially Prepared Red Lead for Flint-Glass Making.

CHARLES LOWE & CO.,

(Established 1860.)

FACTORIES.
Reddish and Bradford,
MANCHESTER.
BRONZE MEDAL, PARIS, 1867.

TOWN OFFICES:
61, Piccadilly,
MANCHESTER.
GOLD MEDAL, PARIS, 1878.

MANUFACTURERS OF

Pure Carbolic Acid, Cryst. at 42°·2 C. } Discovered
,, ,, do. Hydrate of } by C. Lowe
Medicinal do. Cryst. at 35° C.
Commercial do. No. 1 ,, 35° C.
,, do. 2 ,, 29° C.
,, do. 3 ,, 12° C.
,, do. 4 liquid at 0° C.
Carbolic Acid Disinfecting Powder.

Carbolic Acid Glycerine Solutions.
Cresylic Acid.
Sulpho-Phenic Acid (Cryst.)
Sulpho-Phenates & Sulpho-Cresylates of Soda, Potash, Zinc, Iron, and Alumina.

Benzol (Cryst.).
Anthracene.
Naphthaline.
Picric Acid (Cryst. and Paste).
Aurine (Rosolic Acid) Cake and Solution.

JOHN CLIFF,
STONEWARE MANUFACTURER,

Late JOHN CLIFF & Co.
Formerly STEPHEN GREEN.
of IMPERIAL POTTERIES,
LAMBETH.

OLD QUAY,
RUNCORN.

London: Printed and Published for the Proprietor by Edwin John Davey, at the Office, Boy Court, Ludgate Hi E.C.
January 21, 1881.

OF
GREAT BRIT

THE

CHEMICAL NEWS

AND

JOURNAL OF PHYSICAL SCIENCE

Edited by Wm. Crookes, F.R.S.] (WITH WHICH IS INCORPORATED THE "CHEMICAL GAZETTE") [*Established Thirty-Eight Years.*

Vol. 43.—No. 1105.] *Copyright reserved.* Friday, January 28, 1881. *Registered as a Newspaper.* [PRICE, 4d. POST FREE, 4½d.

CONTENTS.

CAPPER PASS AND SON, BRISTOL,
ARE BUYERS OF
LEAD ASHES, SULPHATE OF LEAD,
LEAD SLAGS, ANTIMONIAL LEAD,
COPPER MATTE, TIN ASHES, &c.,
and DROSS or ORES containing
COPPER, LEAD, AND ANTIMONY.

An Analytical Chemist is desirous of obtaining for a Young Man, who has been his Assistant for four years, an independent position as Chemist in Metal or other Works, or a situation in a good laboratory in general practice. Most satisfactory testimony can be borne as to character and ability.—Address, Mr. R. Routledge, F.C.S., North Eastern Railway, Greensfield, Gateshead-on-Tyne.

Assistant Chemist required who has had experience in analysing Chemical Manures.—Address, stating salary wanted, experience acquired, and references, to A. C., Thomas Farmer and Co., Dunster House, Mark Lane, London, E C.

A Chemical Assistant, used to the Analysis of Mineral Phosphates and Manures, required at once. Good references.—Apply by letter, stating salary required, to X. 41, Messrs. Dawson and Sons, 121, Cannon Street, E.C.

Advertiser, thoroughly conversant with Chemistry, Theoretical and Applied, experienced in O.V., Weldon, Deacon, Soda-ash, Crystals, Cream White, and 76 per cent Caustic Soda, &c. Could take the supervision of whole or part of works or loboratory, conduct research, and introduce improvements.—Address, Natrone, CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.

TO TAR DISTILLERS.
A Steady Young Man seeks Situation as Working Foreman. Fully conversant with the manufacture of all Tar Products, Sulphate of Ammonia, and Cl. Good manager of men.—Address, John Fraser, 50, Herriott Street, Liverpool, N.

Metallurgical Engineer, shortly at liberty, seeks Re-engagement as Manager of Smelting Works. Educated at Freiburg. Experienced in planning and erecting metallurgical plant, especially lead smelting and desilverising, and in general and technical management. Practised Chemist and Assayer. At present Assistant Manager of one of largest Lead and Silver Works in Europe. Highest testimonials and references.—Address, G. B. W., care of Messrs. G. Street, and Co., 30, Cornhill, E.C.

BRADY & MARTIN,
NEWCASTLE-ON-TYNE,
Will, on application, forward Catalogues of Chemical and Physical Apparatus, Pure Chemicals, Special Reagent Bottles with Embossed Labels, Nitrometer, &c., &c.

GRIFFIN'S
CHEMICAL HANDICRAFT.
SECOND EDITION.
Price 4s. 7d. post free.
A CATALOGUE OF CHEMICAL APPARATUS:
ILLUSTRATED, CLASSIFIED, DESCRIPTIVE.
Demy 8vo., 480 pp., Illustrated with 1600 Woodcuts.
Most complete and cheapest List of Apparatus.
JOHN J. GRIFFIN and SONS, 22, Garrick Street, London, W.C.

This day is published, post 8vo., cloth, 6s.,
PROFESSOR FRANKLAND'S LECTURE NOTES FOR CHEMICAL STUDENTS. Third Edition. Organic Chemistry. Revised and brought up to date by Dr. F. R. Japp, M.A., F.I.C., Demonstrator in the Research Laboratory of the Royal College of Chemistry.
The Volume on Inorganic Chemistry, Sixth Thousand, 4s.
JOHN VAN VOORST, 1, Paternoster Row.

INSTITUTE OF CHEMISTRY.
An Examination in Practical Chemistry in connection with the Institute will be held on Monday, February 21st, 1881, and four following days. Examiner—Dr. W. R. Hodgkinson. Candidates are requested to communicate with the Secretary, Mr. Charles E. Groves, Somerset House Terrace, London, W.C.

PARTNERSHIP.
Wanted, by a Manufacturing Chemist, who has a Chemical Works in London in excellent position, a Partner with Capital to extend the business. Principals or their Solicitors address to G. B., CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.

CHEMICAL NEWS.—Wanted to Purchase Back Numbers or Volumes. Also the new issue of Muspratt's "Arts and Manufactures."—Address, with particulars and price, Box 209, CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.

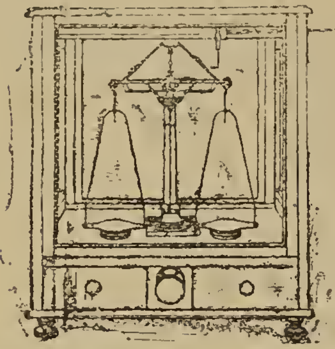
Wanted, Second-hand Balance, Gas Furnace for tube combustion.—Price to T. Graham, Aberdeen Terrace, Clifton, Bristol.

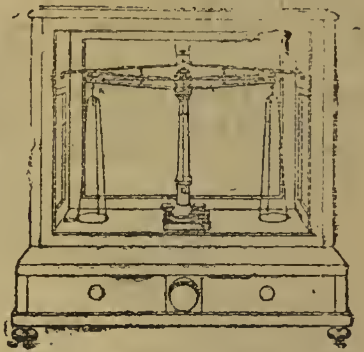
Wanted, a Second-hand Revolving Black-ash Cylinder.—Apply to W. and H. M. Goulding (Limited), Dublin.

Wanted for America—A thoroughly capable, Practical and Scientific Chemist, competent to make Ammoniacal Products from Gas water. Also one to make Sulphate of Copper and Acetic Acid by the latest and best processes.—Address, Box, 2660, New York P.O., U.S.A.

FOR SALE, Price £100.—A rapidly growing analytical practice in the West of England. To be sold because the owner is leaving England.—Apply by letter, G. W. R., 52, Drury Lane, London, W.C.

FOR SALE, a Bargain.—Centrifugal Pump, by Gwynne and Co., 2-inch bore, with suction-pipe and special metal foot valve, and about 36 feet of strap for same; suitable for Tar or Chemical Works. Also HORIZONTAL ENGINE, 2½-inch bore by 5½-inch stroke, on strong metal foundation bed, pulley on shaft 9 inches diameter. Both in good condition, equal to new.—Apply to Chas. Lamb and Co., 60, Mark Lane, E.C.





London: Printed and Published for the Proprietor by Edwin John Davey, at the Office, Boy Court, Ludgate Hi E.C.
January 28, 1881.

THE CHEMICAL NEWS AND JOURNAL OF PHYSICAL SCIENCE

Edited by Wm. Crookes, F.R.S.] (WITH WHICH IS INCORPORATED THE "CHEMICAL GAZETTE") [Established Thirty-Eight Years.

Vol. 43.—No. 1106.] Copyright reserved. Friday, February 4, 1881. Registered as a Newspaper. [PRICE, 4d. POST FREE, 4½d.

CONTENTS.

CAPPER PASS AND SON, BRISTOL,

ARE BUYERS OF

LEAD ASHES, SULPHATE OF LEAD,
LEAD SLAGS, ANTIMONIAL LEAD,
COPPER MATTE, TIN ASHES, &c.,
and DROSS or ORES containing
COPPER, LEAD, AND ANTIMONY.

An Analytical Chemist is desirous of obtaining for a Young Man, who has been his Assistant for four years, an independent position as Chemist in Metal or other Works, or a situation in a good laboratory in general practice. Most satisfactory testimony can be borne as to character and ability.—Address, Mr. R. Routledge, F.C.S., North Eastern Railway, Greensfield, Gateshead-on-Tyne.

Advertiser, thoroughly conversant with Chemistry, Theoretical and Applied, experienced in O.V., Weldon, Deacon, Soda-ash, Crystals, Cream White, and 76 per cent Caustic Soda, &c. Could take the supervision of whole or part of works or loboratory, conduct research, and introduce improvements.—Address, Natrone, CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.

A Scientific Chemist desires an Engagement. Experienced in the economical management of works and men. First class analyst. Salary moderate.—Address, H. 21, at C. H. May and Co.'s General Advertising Offices, 78, Gracechurch Street, London, E.C.

F.C.S., Aged 21, desires Engagement with a Chemist. Four Years' Practical, Analytical, and General Experience. At home or abroad. References from Dr. Attfield, F.R.S., and Dr. Hassall, and Mr. O. Hehner.—F.C.S., Oxford Villa, Uxbridge.

Wanted, for Export, Twenty Tons of BROWN ACETATE OF LIME Monthly, over Twelve Months.—Address lowest cash price f.o.b. English Port to W. X. 46, Deacon's Advertising Offices, 154, Leadenhall Street, E.C.

Wanted, to Purchase Volumes 1, 3, 5, 6, and 7, of the 'Journal of the Chemical Society"; also Vol. 3 of the 'Proceedings of the Royal Society."—Address, K. P. G., CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.

BRADY & MARTIN,
NEWCASTLE-ON-TYNE,
Will, on application, forward Catalogues of Chemical and Physica
paratus, Pure Chemicals, Special Reagent Bottles with Embossed
Labels, Nitrometer, &c., &c.

GRIFFIN'S
CHEMICAL HANDICRAFT.
SECOND EDITION.
Price 4s. 7d. post free.

A CATALOGUE OF CHEMICAL APPARATUS:
ILLUSTRATED, CLASSIFIED, DESCRIPTIVE.
Demy 8vo., 480 pp., Illustrated with 1600 Woodcuts.
Most complete and cheapest List of Apparatus.

JOHN J. GRIFFIN and SONS, 22, Garrick Street,
London, W.C.

HOXHEAD'S FAT EXTRACTOR.

The most Accurate, Quickest, and Cheapest Form of Apparatus for this Work. Price 3s., unmounted. With Still and Condenser complete, 6s.

JOHN J. GRIFFIN and SONS, 22, Garrick Street,
London, W.C.

THE JOURNAL OF SCIENCE
for FEBRUARY (Price 1s. 6d.), includes—
The Early Practice of Medicine by Women. By Prof. H. Carrington Bolton, Ph.D.
Life and its Basis. By J. H. Barker, M.A.
The Formative Power in Nature. By Sidney Billing.
Experiments with the "Jnmpers" of Maine. By George M. Beard, M.D.
A Defence of the Dog. By H. Bellyse Baildon.
A Safety Paper for Cheques.
Analyses of Books. Correspondence. Notes.
London: 3, Horse-Shoe Court, Ludgate Hill.

This day is published, post 8vo., cloth, 6s.,

PROFESSOR FRANKLAND'S LECTURE NOTES FOR CHEMICAL STUDENTS. Third Edition. Organic Chemistry. Revised and brought up to date by Dr. F. R. Japp, M.A., F.I.C., Demonstrator in the Research Laboratory of the Royal College of Chemistry,

The Volume on Inorganic Chemistry, Sixth Thousand, 4s.

JOHN VAN VOORST, 1, Paternoster Row.

TO CHEMICAL MANUFACTURERS. For Sale, by Public Roup, within the Faculty Hall, St. George's Place, Glasgow. on Wednesday, the 16th day of February, 1881, at Two o'clock Afternoon.

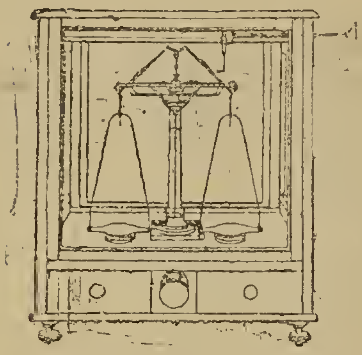
The LEASE and Whole BUILDINGS, PLANT, and MACHINERY, belonging to the PORT-DUNDAS ALKALI CO. (LD.) in Liquidation, of and in their Works at Port-Dundas, Glasgow.

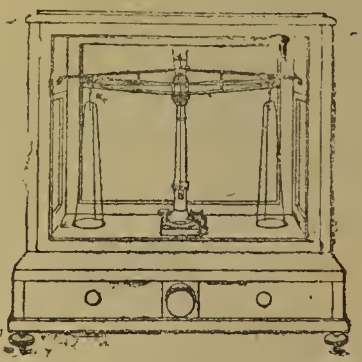
The Plant, which has been erected within the last three years, is capable of producing about 120 tons Caustic Soda, 160 tons Soda Ash, and 40 tons Hydrated Carbonate of Potash per month, and of working up, in the manufacture of Iodine, from 20 to 25 tons of Kelp per week. A Limekiln and suitable Furnaces for roasting Nitre-Cake form part of the Plant.

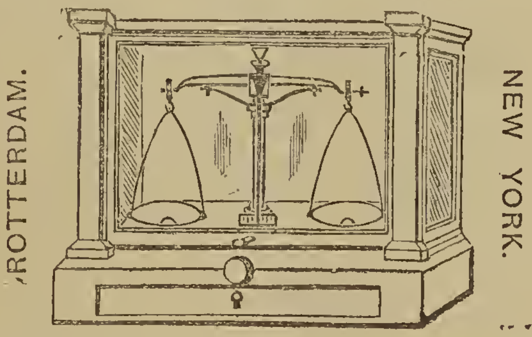
The Ground and part of the Buildings are held on lease from the North British Railway Company at a moderate rent. The Works are most favourably placed as regards Raw Material and Local Markets for Produce, and possess exceptional facilities for transit, being situated on the Forth and Clyde Canal, with a Railway Siding running into the Yard.

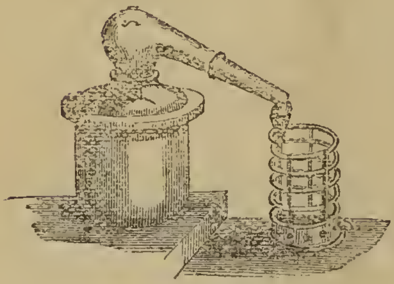
The Works are at present in operation, and will be sold as a going concern. The Purchaser will be taken bound to take over the Stock on hand and in process at a valuation.

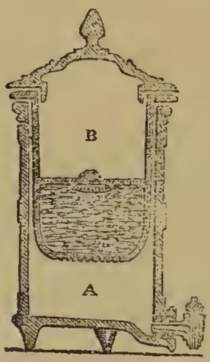
For further particulars apply to Carson and Watson, C.A., 79, West Regent Street; or to Dill, Wilson, and Muirhead, Writers, 54, West Nile Street, Glasgow.

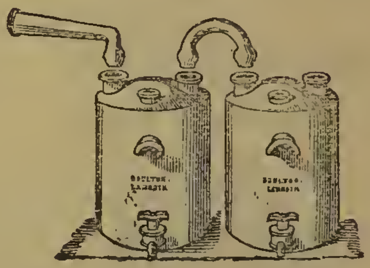





ROTTERDAM.
NEW YORK.







London: Printed and Published for the Proprietor by Edwin John Davey, at the Office, Boy Court, Ludgate Hi E.C.
February 4, 1881.

THE

CHEMICAL NEWS

AND

JOURNAL OF PHYSICAL SCIENCE

Edited by Wm. Crookes, F.R.S.] (WITH WHICH IS INCORPORATED THE "CHEMICAL GAZETTE") [*Established Thirty-Eight Years.*

Vol. 43.—No. 1107.] *Copyright reserved.* Friday, February 11, 1881. *Registered as a Newspaper.* [PRICE, 4d. POST FREE, 4½d.

CONTENTS.

CAPPER PASS AND SON, BRISTOL,

ARE BUYERS OF

LEAD ASHES, SULPHATE OF LEAD,
LEAD SLAGS, ANTIMONIAL LEAD,
COPPER MATTE, TIN ASHES, &c.,
and DROSS or ORES containing
COPPER, LEAD, AND ANTIMONY.

Advertiser, thoroughly conversant with Chemistry, Theoretical and Applied, experienced in O.V., Weldon, Deacon, Soda-ash, Crystals, Cream White, and 76 per cent Caustic Soda, &c. Could take the supervision of whole or part of works or loboratory, conduct research, and introduce improvements.—Address, Natrone, CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.

Advertiser will shortly be open for an Engagement as Manager or Under-Manager in a Chemical Works. Has long practical experience in the Alkalies and Artificial Manure Trade, and the Mineral Acids. Is a good Draughtsman and capable of erecting chemical plant on the most improved principles. Can give most satisfactory references, &c.—Address to N., care of George G. Blackwell, Esq., 26, Chapel Street, Liverpool.

Advertiser, thoroughly conversant with the Manufacture of Sulphate of Ammonia, and other products, made from a new and abundant waste-product, which gives a nett profit of £10 a ton, is open to an engagement as Manager, or otherwise.—T. S., CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.

BOROUGH OF SALFORD GAS WORKS.—TO TAR DISTILLERS, &c.—Extension of time.—The time for sending in TENDERS for the TAR and AMMONIACAL LIQUOR for a period of three years from the 13th of July next, is extended to the 1st of March next.—By Order,

CHRIS. MOORHOUSE, Town Clerk.

Town Hall, Salford, 4th February, 1881.

BRADY & MARTIN,
NEWCASTLE-ON-TYNE,

Will, on application, forward Catalogues of Chemical and Physica Apparatus, Pure Chemicals Special Reagent Bottles with Embossed Labels, Nitrometer, &c., &c.

GRIFFIN'S
CHEMICAL HANDICRAFT.
SECOND EDITION.
Price 4s. 7d. post free.

A CATALOGUE OF CHEMICAL APPARATUS:
ILLUSTRATED, CLASSIFIED, DESCRIPTIVE.
Demy 8vo., 480 pp., Illustrated with 1600 Woodcuts.
Most complete and cheapest List of Apparatus.

JOHN J. GRIFFIN and SONS, 22, Garrick Street, London, W.C.

XOXHEAD'S FAT EXTRACTOR.

The most Accurate, Quickest, and Cheapest Form of Apparatus for this Work. Price 3s., unmounted. With Still and Condenser complete, 6s.

JOHN J. GRIFFIN and SONS, 22, Garrick Street, London, W.C.

THE JOURNAL OF SCIENCE
for FEBRUARY (Price 1s. 6d.), includes—

The Early Practice of Medicine by Women. By Prof. H. Carrington Bolton, Ph.D.
Life and its Basis. By J. H. Barker, M.A.
The Formative Power in Nature. By Sidney Billing.
Experiments with the "Jnmpers" of Maine. By George M. Beard, M.D.
A Defence of the Dog. By H. Bellyse Baildon.
A Safety Paper for Cheques.
Analyses of Books. Correspondence. Notes.

London: 3, Horse-Shoe Court, Ludgate Hill.

This day is published, post 8vo., cloth, 6s.,

PROFESSOR FRANKLAND'S LECTURE NOTES FOR CHEMICAL STUDENTS. Third Edition. Organic Chemistry. Revised and brought up to date by Dr. F. R. Japp, M.A., F.I.C., Demonstrator in the Research Laboratory of the Royal College of Chemistry,

The Volume on Inorganic Chemistry, Sixth Thousand, 4s.

JOHN VAN VOORST, 1, Paternoster Row.

INSTITUTE OF CHEMISTRY.

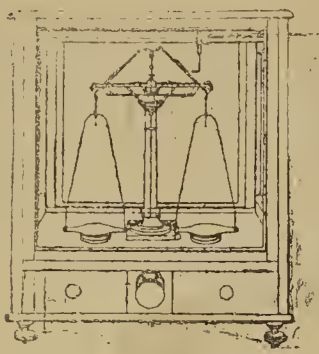
An Examination in Practical Chemistry in connection with the Institute will be held on Monday, February 21st, 1881, and four following days. Examiner—Dr. W. R. Hodgkinson. Candidates are requested to communicate with the Secretary, Mr. Charles E. Groves, Somerset House Terrace, London, W.C.

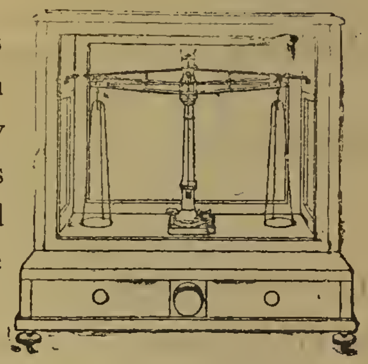
LIVERPOOL COLLEGE of CHEMISTRY,
LIVERPOOL.

FOUNDER—Dr. SHERIDAN MUSPRATT.
PRINCIPALS—Dr. TATE and GRANVILLE H. SHARPE.

Special advantages offered to Students. Assays, Analyses, and Chemical Investigations conducted.
For Prospectuses apply to the Principals.

Wanted, a Second-hand Chemical Balance. Short beam preferred. Must be in good condition.—Address, stating price, to Alpha, CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.





SPECIALITIES.

MANGANESE—Finest Crystallised, Lump, Ground, and Granulated of every quality, and Prepared for *Chlorine, Glass, Steel, Ferro-Manganese Pottery, Battery,* and Every Purpose.

BAUXITE—(Hydrate of Alumina) Of high percentage of Alumina and almost free from Iron. The Cheapest, Best, and Most Profitable article from which to produce Alum, Alum Cake, and Sulphate of Alumina, &c. [BRAND, "IRISH HILL BAUXITE."]

FLUOR-SPAR—Of the Very Finest Quality for Acid, Soda, Glass Flux, and all purposes

BARYTES—(Carbonate and Sulphate. Crystallised, Selected Lump and Ground for all uses.

CRYOLITE—Magnesite, Felspar, Arsenic, Phosphates, French Chalk, Strontia, Wolfram, Chrome, Terra Alba, Rotten Stone, China Clay, Umbers Ochres, Antimony, Calamine, Emery Stone all Oxides, and all

FULLER'S EARTH—Of superior quality, and entirely free from grit. [BRAND, "EMERALD."]

MINERALS, CHEMICALS, AND COLOURS.

GEO. G. BLACKWELL,

MINE PROPRIETOR,

Manganese and Mineral Works, Grinding Mills, and Ore Yards, GARSTON.

OFFICES—26 CHAPEL STREET LIVERPOOL.

Established 1798.

ROBERT DAGLISH & CO.,

ENGINEERS, BOILER AND BRIDGE MAKERS, MILLWRIGHTS,

BRASS AND IRON FOUNDERS.

Manufacturers of every description of Condensing, or High-pressure Blowing, Pumping, Rolling, Winding, and Patent Steam-engines, of any required power, for Irrigating, Draining, Mining, Rolling Mills, or Water Works purposes, and Manufacturers of every description of Chemical, Colliery, Copper Ore, Gold Mining, Glass, and Rock-salt Machinery.

Black-ash Revolving Furnaces of the Most Approved Type.

Bessemer Steel-Rail Plant.

Compressing-Engines for Collieries, Iron Works, and Weldon's Patent Bleaching-Powder Process.

Caustic, Chlorate, Decomposing, Nitre Nitro-Glycerine, Iodine Potash, Sulphur, Acid, and Oxalic Pans.

Gas Producers Patent for Heating and other Purposes.

Pyrites Burners for Irish, Norwegian, and Spanish Ores of Improved Construction.

Patent Rousing Machinery for Brewers.

Retorts, Acid, Gas, Iodine, Nitric, Nitre Nitro-Glycerine and Vitriol Refining.

Steam Superheaters improved for Oil, Tar, and Resin Refining.

Steam Sulphur Melter.

Stills for Oil, Resin, and Tar.

Wheels, Bevel, Mitre, and Spur Moulded on the Shortest Notice by Patent Machinery.

Makers of Mactear's Patent Carbonating Furnace, Jones and Walsh's Patent Sulphate of Soda Furnace, Parnell and Simpson's Patent Causticiser, and Kynaston's Patent Alum Plan

Lists sent on Application.

Photographs, Plans, and other information supplied on receipt of Order.

ST HELEN'S ENGINE, BOILER, AND BRIDGE WORKS AND FOUNDRY,

LANCASHIRE.

BETHESDA MINERAL SPRING,

WAUKESHA, WISCONSIN, U.S.A.

Invaluable in Diabetes, Bright's Disease, Urinary Diseases Dyspepsia. A Mild Aperient. Sold by all Chemists and Mineral Water Agents. Agents wanted.

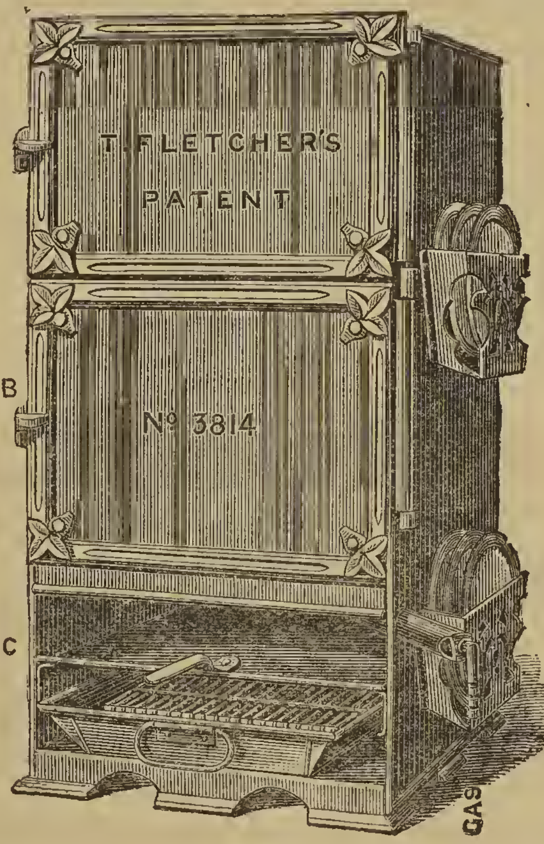
For special terms and further information apply to CEARNS and BROWN, 32, Chapel Street, Liverpool.

FLETCHER'S

PATENT VENTILATED

HOT-AIR OVEN.

At a cost of less than one halfpenny per hour for gas, this oven will grill, roast, toast, bake, warm dishes and plates; and with the assistance of Fletcher's Patent Solid Flame Boiling Burners will do everything possible with a first rate open fire (except drying clothes on washing days).



It is unapproached by any oven for pastry, and is fully hot in one minute after the gas is lighted.

Fish, joint, and pastry can be cooked all at once, in the most perfect manner, without the slightest taint from one to the other. The cooking is always good and always alike.

It will roast joint and fowls both at once, at least as well as an open fire.

Complete illustrated list of gas cooking and labour saving appliances free by post. List of Gas and Petroleum Laboratory Furnaces and Apparatus, price 2d.

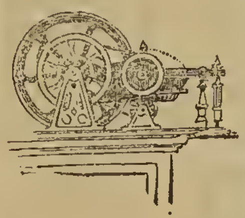
THOS. FLETCHER,

4 & 6, MUSEUM STREET, WARRINGTON.

Carr's Patent Paint and Drug Mill.

Approved by some of the most eminent Chemists, and awarded the Silver Prize Medals of the Manchester and Liverpool, and the Middleton Agricultural Shows.

From Messrs. E. H. Smyth & Co, 21 Duke Street, Edinburgh, and 69, Coleman Street, City, London.—The small Levigator Mill we recently got from you works most efficiently, and is a great economiser of time.



The chief feature in this machine is, that although it can be turned with ease by a boy, it has immense frictional power for levigating purposes. This is caused by the runner being driven at a much greater speed, but in the same direction, than the bowl. The surfaces being Minton ware, they are clean, smooth, and durable.

Testimonials on application.

£11 nett cash, delivered in Manchester.

The diameter of the bowl is 18 ins., and it and the runners are made of Minton ware. It is useful for Painters, Chemists, Grocers, and Cooks, for triturating and mixing Medicines, Vegetable Powders, Ointments, Paints, Sugar, Salt, Spices, Herbs, Meat for Potting, and will grind the coarsest Emery into a nearly Impalpable Powder in a few seconds. The pan can be tilted for emptying, as shown in the dotted lines; it can be worked by hand or power.

SOLE MAKERS—

W. H. BAILEY & Co., Albion Works, Salford, Manchester.

London: Printed and Published for the Proprietor by EDWIN JOHN DAVEY, at the Office, Boy Court, Ludgate Hi E.C., February 11, 1881.

PHARMACEUTICAL SOCIETY OF GREAT BRITAIN

THE CHEMICAL NEWS

AND

JOURNAL OF PHYSICAL SCIENCE

Edited by Wm. Crookes, F.R.S. (WITH WHICH IS INCORPORATED THE "CHEMICAL GAZETTE") Established Thirty-Eight Years.

Vol. 43.—No. 1108. Copyright reserved. Friday, February 18, 1881. Registered as a Newspaper. PRICE, 4d. POST FREE, 4½d.

CONTENTS.

ARTICLES:— PAGE

CAPPER PASS AND SON, BRISTOL,
ARE BUYERS OF
LEAD ASHES, SULPHATE OF LEAD,
LEAD SLAGS, ANTIMONIAL LEAD,
COPPER MATTE, TIN ASHES, &c.,
and DROSS or ORES containing
COPPER, LEAD, AND ANTIMONY.

Advertiser, thoroughly conversant with Chemistry, Theoretical and Applied, experienced in O.V., Weldon, Deacon, Soda-ash, Crystals, Cream White, and 76 per cent Caustic Soda, &c. Could take the supervision of whole or part of works or laboratory, conduct research, and introduce improvements.—Address, Natrone, CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.

Advertiser, thoroughly conversant with the Manufacture of Sulphate of Ammonia, and other products, made from a new and abundant waste-product, which gives a nett profit of £10 a ton, is open to an engagement as Manager, or otherwise.—T. S., CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.

A Distinguished Chemist (Practical and Theoretical) desires co-operation of influential capitalists for the purpose of working some of his very important and highly valuable Inventions.—Address, in first instance, to N. Battersby, Solicitor, Manchester.

The Advertiser, a thoroughly Practical Man, who has had upwards of ten years' experience in the manufacture of Nitro-glycerine, Gun-cotton, Sulphuric Acid, Nitric Acid, Sulphate of Ammonia, and Coal tar Products, seeks an Engagement as Manager or Assistant Manager, at home or abroad. First class references.—Address, "Nitro-compound," CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.

Wanted, a Second-hand Chemical Balance. Short beam preferred. Must be in good condition.—Address, stating price, to Alpha, CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.

BRADY & MARTIN,
NEWCASTLE-ON-TYNE,
Will, on application, forward Catalogues of Chemical and Physical Apparatus, Pure Chemicals Special Reagent Bottles with Embossed Labels, Nitrometer, &c., &c.

GRIFFIN'S
CHEMICAL HANDICRAFT.
SECOND EDITION.
Price 4s. 7d. post free.

A CATALOGUE OF CHEMICAL APPARATUS:
ILLUSTRATED, CLASSIFIED, DESCRIPTIVE.
Demy 8vo., 480 pp., Illustrated with 1600 Woodcuts.
Most complete and cheapest List of Apparatus.

JOHN J. GRIFFIN and SONS, 22, Garrick Street, London, W.C.

XOXHEAD'S FAT EXTRACTOR.

The most Accurate, Quickest, and Cheapest Form of Apparatus for this Work. Price 3s., unmounted. With Still and Condenser complete, 6s.

JOHN J. GRIFFIN and SONS, 22, Garrick Street, London, W.C.

THE JOURNAL OF SCIENCE
for FEBRUARY (Price 1s. 6d.), includes—
The Early Practice of Medicine by Women. By Prof. H. Carrington Bolton, Ph.D.
Life and its Basis. By J. H. Barker, M.A.
The Formative Power in Nature. By Sidney Billing.
Experiments with the "Jumpers" of Maine. By George M. Beard, M.D.
A Defence of the Dog. By H. Bellyse Baildon.
A Safety Paper for Cheques.
Analyses of Books. Correspondence. Notes.
London: 3, Horse-Shoe Court, Ludgate Hill.

DESTRUCTIVE DISTILLATION: A Manualette of the Paraffin, Coal-tar, Rosin, Oil, Petroleum, and kindred Industries. By EDMUND J. MILLS, D.Sc. (Lond.), F.R.S., "Young" Professor of Technical Chemistry in Anderson's College, Glasgow.

"Will be found useful by both students and manufacturers."—*English Mechanic.*

"In a small space conveys a great deal of useful information."—*Journal of Gas Lighting.*

London: VAN VOORST.

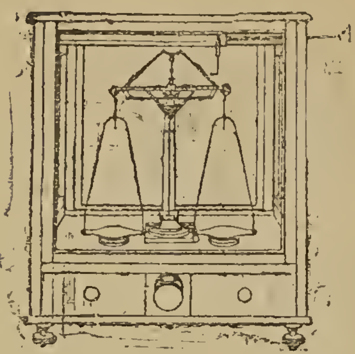
LIVERPOOL COLLEGE of CHEMISTRY,
LIVERPOOL.
FOUNDER—Dr. SHERIDAN MUSPRATT.
PRINCIPALS—Dr. TATE and GRANVILLE H. SHARPE.

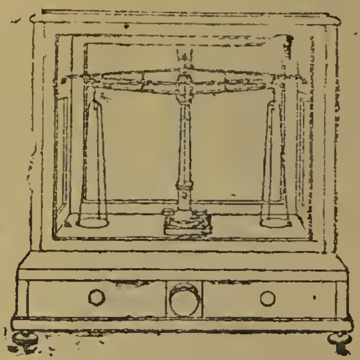
Special advantages offered to Students. Assays, Analyses, and Chemical Investigations conducted.
For Prospectuses apply to the Principals.

SULPHUR.

Wanted, to Buy Material Free from Arsenic, for making into Sulphuric Acid, by a large Vitriol Maker.—Address, C. H. L., CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.

Wanted, Re-engagement as Managing Foreman of Vitriol Plant. Knowledge of Manures. References given.—Apply, G., CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.





WORKS ON SCIENCE AND THE USEFUL ARTS

PUBLISHED BY MESSRS. LONGMANS & CO.

GANOT'S ELEMENTARY TREATISE on PHYSICS, Experimental and Applied, for the Use of Colleges and Schools. Translated and edited, with the Author's sanction, by E. ATKINSON, Ph.D., F.C.S. Professor of Experimental Science, Staff College. The Ninth Edition, with 4 Coloured Plates and 844 Woodcuts. Large crown 8vo. price 15s.

"This well-known work has been before the public for sixteen years, and has now reached a ninth edition. Each new addition has contained both additions and revisions in accordance with the progress of science. The present edition differs from the last by an increase of subject-matter of twenty-five pages, while twenty-four new illustrations have been added. The illustrations are extremely good, and the various subjects are discussed with a sufficient infusion of mathematics to make the book serviceable for the use of the highest forms in schools and for scholarship and other examinations." ACADEMY.

GANOT'S NATURAL PHILOSOPHY, for GENERAL READERS and YOUNG PERSONS; a Course of Physics divested of Mathematical Formulæ and expressed in the language of daily life. Translated and edited, with the Author's sanction, by E. ATKINSON, F.C.S. The Fourth Edition, completely revised; with 25 pages of New Matter, 2 Coloured Plates, and 471 Woodcuts, of which 16 are New in this Edition. Crown 8vo. price 7s. 6d.

"We are glad to notice this volume, which will prove useful to a wide circle of readers and teachers, since it represents the amount of knowledge required for the matriculation examination of the London University. It is divided into eight books, treating respectively of the General Properties of Matter, Hydrostatics, Gases, Acoustics, Heat, Light, Magnetism, and Electricity. It is admirably illustrated, and throughout most clearly written. It ought to be in the hands of the higher classes of all our public schools; and if the principal facts it contains were early demonstrated by experiment to those about to become members of the profession, we should have a far larger number of accurate observers, and much fewer loose theories than at present." LANCET.

POPULAR LECTURES on SCIENTIFIC SUBJECTS, SECOND SERIES, comprising the Origin and Signification of Geometrical Axioms, the relation of Form, Shade, Colour and Harmony of Colour to Painting, the Origin of the Planetary System, &c. By H. HELMHOLTZ, Prof. of Physics in the Univ. of Berlin. Translated by E. ATKINSON, Ph.D., F.C.S., Prof. of Experimental Science, Staff College. With 17 Woodcuts. Crown 8vo. price 7s. 6d.

PROFESSOR HELMHOLTZ' FIRST SERIES of LECTURES on SCIENTIFIC SUBJECTS. Translated by Professor ATKINSON, with Introduction by Professor TYNDALL, F.R.S. Second Edition, revised; with 51 Woodcuts, uniform with the Second Series. Crown 8vo. price 7s. 6d.

FRAGMENTS of SCIENCE; a Series of detached Essays, Addresses, and Reviews. By JOHN TYNDALL, LL.D., D.C.L., F.R.S. Sixth Edition, revised and augmented. 2 vols. crown 8vo. 16s.

HEAT a MODE of MOTION. By JOHN TYNDALL, LL.D., D.C.L., F.R.S. Sixth Edition (Thirteenth Thousand), thoroughly revised and enlarged; with Frontispiece and 123 Woodcuts. Crown 8vo. 12s.

The ELEMENTS OF MECHANISM. By T. M. GOODEVE, M.A., Barrister-at-Law, Lecturer on Applied Mechanics at the Royal School of Mines. New Edition, rewritten and enlarged; with 342 Woodcuts. Crown 8vo. 6s.

MILLER'S ELEMENTS of CHEMISTRY, Theoretical and Practical. Part I. *Chemical Physics.* Sixth Edition, revised, with Additions, by H. MACLEOD, F.C.S. With 274 Woodcuts. 8vo. 16s.

MILLER'S ELEMENTS of CHEMISTRY. Part II. *Inorganic Chemistry.* Sixth Edition, revised throughout, with Additions by C. E. GROVES. With 376 Woodcuts. 8vo. 24s.

MILLER'S ELEMENTS of CHEMISTRY. Part III. Fifth Edition, revised, and for the most part rewritten, by H. E. ARMSTRONG, F.R.S., and C. E. GROVES, F.C.S. The Chemistry of Carbon Compounds, or Organic Chemistry, in Two Sections. SECTION I. *Hydrocarbons, Alcohols, Ethers, Aldehides,* and *Paraffinoid Acids*; with 20 Woodcuts. 8vo. 31s. 6d. SECTION II. completion, is in the press.

DICTIONARY of CHEMISTRY and the ALLIED BRANCHES of OTHER SCIENCES. By HENRY WATTS, F.R.S., Editor of the Journal of the Chemical Society, assisted by eminent Scientific and Practical Chemists. 7 vols. 8vo. £10 16s. 6d.

THIRD SUPPLEMENTARY VOLUME, completing the Record of Chemical Discovery to the year 1877. In Two Parts. PART I. 8vo. price 36s. PART II., completion, in the Press.

URE'S DICTIONARY of ARTS, MANUFACTURES, and MINES; Containing a clear Exposition of their Principles and Practice. The Seventh Edition, completely revised and greatly enlarged by ROBERT HUNT, F.R.S., Keeper of Mining Records, assisted by F. W. RUDLER, F.G.S., and by numerous Contributors. With above 2604 Woodcuts. 4 vols. medium 8vo. price £7 7s.

On ARTIFICIAL MANURES, their Chemical Selection and Scientific Applications to Agriculture; a Series of Lectures given at the Experimental Farm, Vincennes. By GEORGES VILLE. Translated and edited by W. CROOKES, F.R.S., V.P.C.S. With 31 Illustrations, 8vo. 21s.

A TREATISE on MILLS and MILLWORK. By the late Sir W. FAIRBAIRN, Bart. C.E. Fourth Edition, with 18 Plates and 333 Woodcuts. 1 vol. 8vo. 25s.

A HANDBOOK of PRACTICAL TELEGRAPHY. By R. S. CULLEY, Member Inst. C.E., Engineer-in-Chief of Telegraphs to the Post Office. Seventh Edition, revised and enlarged; with 132 Woodcuts and 18 Lithographic Plates of Apparatus. 8vo. 16s.

London, LONGMANS, GREEN, & CO.

THE CHEMICAL NEWS
AND
JOURNAL OF PHYSICAL SCIENCE.

Edited by WILLIAM CROOKES, F.R.S.

Published every Friday. Price 4d. Annual Subscription, post free including Indices, £1

CHARGES FOR ADVERTISEMENTS.

	£	s.	d.
Five lines in column (about 10 words to line)	0	3	6
Each additional line	0	0	6
Whole column	1	15	0
Whole page	3	0	0

A reduction made for a series of insertions.

Cheques and Post-Office Orders, crossed "London and County Bank," payable to the order of William Crookes.

BOY COURT, LUDGATE HILL LONDON, E.C

KÖRTING BROTHERS,
ENGINEERS,
17, LANCASTER AVENUE, FENNEL STREET,
MANCHESTER.

Air Compresser.

PATENT STEAM-JET AIR COMPRESSERS for oxidising caustic alkalies and agitating liquids.

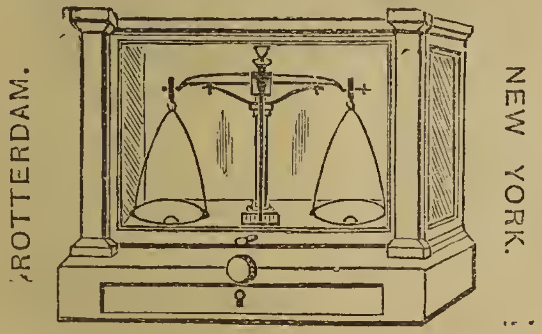
PATENT STEAM-JET EJECTORS to give a vacuum up to 27 feet of water.

SUPPLIED TO:—

The Blaydon Manure and Alkali Co., Lim.
Messrs. Brooke, Simpson, and Spiller, Hackney Wick.
Messrs. Burt, Boulton, and Haywood, Silvertown.
,, Chance, Bros., Oldbury.
,, N. and J. H. Fenner, London.
The Ford Works Co., Lim., Sunderland.
Messrs. Gaskell, Deacon, and Co., Widnes.
,, Wm. Gossage and Sons, Widnes.
,, Grimble and Co , London.
,, Hardman and Co., Manchester.
,, Holmes and Partner, Warrington.
,, Jno. Hutchinson and Co., Widnes.
The Jarrow Chemical Company, Gateshead.
Messrs. D. Martineau and Sons, London.
,, Jas. Muspratt and Sons, Widnes.
The North British Chemical Co., Dalmuir.
The Patent Sulphate Copper Company Macclesfield.
Messrs. Jno. Riley and Sons, Hapton.
,, Roberts, Dale, and Co., Manchester.
,, Robinson, Pollard, and Co., Portsea.
,, Stainsby and Lyon, Knottingley.
,, Taylor, Greenall, and Kidd, Widnes.
,, C. Tennant and Co., Glasgow.
,, Wells and Galloway, Lim., Widnes.
,, Rd. Wheen and Sons, London.
The Widnes Alkali Co., Widnes.

Circulars and Testimonials on Application.

BECKER & SONS,
MANUFACTURERS OF
CHEMICAL AND GOLD ASSAY BALANCES
AND OTHER
SCALES AND WEIGHTS.



BECKER'S STUDENT'S BALANCE, in polished mahogany glass case, sliding front, counterpoised, to carry 30 grammes in each pan and turn to ½ milligramme, nickel plated pans £2 10
Ditto, ditto, in mahogany glass case, polished black.. .. .. £2 13

Sole Agents for England, Ireland, and Wales:—
TOWNSON & MERCER.

Becker's Complete Lists forwarded by post on receipt of 1*d*. stamp or free on application.

SOUTH LONDON CENTRAL PUBLIC LABORATORY.

A Department has been opened for the Private Instruction of Gentlemen in Practical Chemistry as applied to any Special Industries or Commercial Products they may wish to study. For Fees, &c., apply to W. Baxter, Secretary, Central Public Laboratory, Kennington Cross, S.E.

BISULPHIDE OF CARBON
PROTOSULPHATE
RED OXIDE
OXYCHLORIDE
Sulphocyanide,
And every other Mercurial Preparation.
BISULPHITE OF LIME, TETRACHLORIDE OF CARBON.
Oxysulphuret of Antimony, Glacial Acetic Acid,

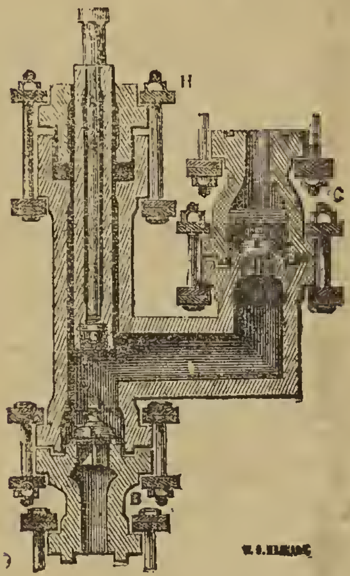
Liquor Ammoniæ,
Sulphide of Iron,
Pure Acids,
Chloride of Sulphur,
Acetone,
Chloroform,
Aldehyde,
Chlorate Baryta,
Arsenic Acids,
Fruit Essences for Confectionery & Liqueurs,
Perchloride of Iron,
Sulphite and Hyposulphite of Soda,
Phosphates of Soda and Ammonia,
Ethers,
Bromides,
Iodides,
Scale and Granular Preparations,
Sulphide of Sodium.

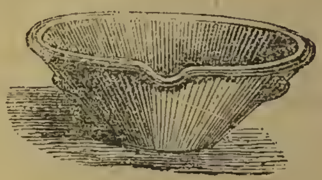
ALSO,
Pure Photographic Chemicals of every kind.
MANUFACTURED BY
WILLIAM BAILEY & SON,
HORSELEY FIELDS CHEMICAL WORKS,
WOLVERHAMPTON.

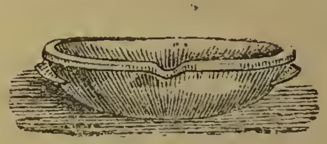
SILICATE OF SODA, Solid and in Solutions of Various Degrees of Concentration: the finest quality obtainable, and especially adapted for the use of Soap Makers and other Consumers.—JOSEPH CROSFIELD and SONS, Soap Makers, &c., Warrington.
London Agent—H. B. CLARKE, Great Tower Street, E.C.

DOULTON & WATTS
HIGH STREET, LAMBETH, LONDON, S.E.
MANUFACTURERS OF
STILLS, RETORTS, CONDENSING WORMS, WOLLF'S BOTTLES,
ACID PUMPS, COCKS, PERCOLATORS, AIR-TIGHT JARS
And every description of Stoneware for Chemical Purposes warranted to resist the strongest acids.

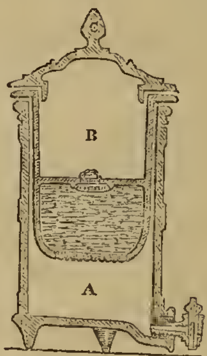
PLUMBAGO CRUCIBLES AND OTHER FIRE-STANDING GOODS.







DOULTONS. MANGANOUS



CARBON FILTER.

(Dr. Bernays's Patent).

The Patent Manganous Carbon Filter combines important improvements in construction which have been effected by Messrs. Doulton & Co., in conjunction with a valuable discovery made by Dr Bernays, Professor of Chemistry at St. Thomas's Hospital; Public Analyst; Chemist to the Kent Water Works, &c., &c., &c.

NEW SHOW ROOMS, ALBERT EMBANKMENT, LAMBETH, S.E.
Depots :—Wood St., Birmingham; 100, Soho St., Liverpool; and 6, Rue de Paradis Poissonière, Paris.

WILLIAM AND WILLIAM T. FIELD,
Manufacturers of the Celebrated STAFFORDSHIRE BLUE BRICKS, specially adapted for Chemical Plant, *i.e.*, Acid Towers, &c. Also all other kinds of Best Staffordshire Blue Bricks, Pavings, Plynths, Splays, Copings, &c. &c. Prices and samples on Application.

TESTIMONIAL

"We have used the Blue Staffordshire Brick or Sulphuric Acid Towers, &c., manufactured by Messrs. Field, for the last fifteen years during which time they have given great satisfaction. We recommend them to the Chemical Trade, believing there is nothing better in the market."—(Signed) WILLIAM HUNT and SONS, Lea Brook Alkali Works, near Wednesbury, Staffordshire, February, 1878.

TOLL END BRICK-WORKS,
TIPTON, STAFFORDSHIRE.

BISULPHIDE OF CARBON
CHLORIDE OF SULPHUR.
GAS PURIFICATION & CHEMICAL CO., LIMITED,
61, 162, 163, Palmerston Buildings, London, E.C.

THOMAS ADKINS & CO.,
SMETHWICK,
NEAR BIRMINGHAM.
Manufacturers of Specially Prepared Red Lead for Flint-Glass Making.

FACTORIES.
Reddish and Bradford,
MANCHESTER.
BRONZE MEDAL, PARIS, 1867.

CHARLES LOWE & CO.,
(Established 1860.)

TOWN OFFICES:
61, Piccadilly,
MANCHESTER.
GOLD MEDAL, PARIS, 1878.

MANUFACTURERS OF

Pure Carbolic Acid, Cryst. at 42°·2 C. } Discovered by C. Lowe
" " do. Hydrate of
Medicinal do. Cryst. at 35° C.
Commercial do. No. 1 " 35° C.
" do. 2 " 29° C.
" do. 3 " 12° C.
" do. 4 liquid at 0° C.
Carbolic Acid Disinfecting Powder.

Carbolic Acid Glycerine Solutions.
Cresylic Acid.
Sulpho-Phenic Acid (Cryst.)
Sulpho-Phenates & Sulpho-Cresylates of Soda, Potash, Zinc, Iron, and Alumina.

Benzol (Cryst.).
Anthracene.
Naphthaline.
Picric Acid (Cryst. and Paste).
Aurine (Rosolic Acid) Cake and Solution.

JOHN CLIFF,
STONEWARE MANUFACTURER,
Late JOHN CLIFF & Co.
Formerly STEPHEN GREEN.
of IMPERIAL POTTERIES,
LAMBETH.
OLD QUAY,
RUNCORN.

London: Printed and Published for the Proprietor by Edwin John Davey, at the Office, Boy Court, Ludgate Hi E.C. February 18, 1881.

SOCIETY
OF
GREAT BRITAIN

THE

CHEMICAL NEWS

AND

JOURNAL OF PHYSICAL SCIENCE

Edited by Wm. Crookes, F.R.S.

(WITH WHICH IS INCORPORATED THE "CHEMICAL GAZETTE")

Established Thirty-Eight Years.

Vol. 43.—No. 1109.] *Copyright reserved.* Friday, February 25, 1881. *Registered as a Newspaper.* [PRICE, 4*d*. POST FREE, 4½*d*.

CONTENTS.

ARTICLES:— PAGE

CAPPER PASS AND SON, BRISTOL,
ARE BUYERS OF
LEAD ASHES, SULPHATE OF LEAD,
LEAD SLAGS, ANTIMONIAL LEAD,
COPPER MATTE, TIN ASHES, &c.,
and DROSS or ORES containing
COPPER, LEAD, AND ANTIMONY.

A Chemist desires a Re-engagement. Has commercial experience, together with a knowledge of Mechanical Engineering, accustomed to conduct research, and would control whole or part of works or laboratory. Salary moderate.—Address, C. A. 3, Deacon's Advertising Offices, Leadenhall Street, E.C.

A Chemical Manufacturer, with extensive Plant and Water Frontage near London, and making a specialité of importance, requires a Partner with about £750.—Address, in first instance, to S. D. L., CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.

Advertiser seeks Engagement as Assistant in Laboratory, or Chemist on Works, at home or abroad; well up in general analysis, also analysis under Food and Drugs Act; four years' experience.—Address, W. B., CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.

Advertiser, thoroughly conversant with Chemistry, Theoretical and Applied, experienced in O.V., Weldon, Deacon, Soda-ash, Crystals, Cream White, and 76 per cent Caustic Soda, &c. Could take the supervision of whole or part of works or laboratory, conduct research, and introduce improvements.—Address, Natrone, CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.

A Distinguished Chemist (Practical and Theoretical) desires co-operation of influential capitalists for the purpose of working some of his very important and highly valuable Inventions.—Address, in first instance, to N. Battersby, Solicitor, Manchester.

PAPER-MAKING.

Wanted, a thorough article on Paper-making, for a large Industrial Work.—State qualifications to Mr. Lock, 16, Charing Cross, S.W.

BRADY & MARTIN,
NEWCASTLE-ON-TYNE,
Will, on application, forward Catalogues of Chemical and Physical Apparatus, Pure Chemicals Special Reagent Bottles with Embossed Labels, Nitrometer, &c., &c.

GRIFFIN'S
CHEMICAL HANDICRAFT.
SECOND EDITION.
Price 4s. 7d. post free.

A CATALOGUE OF CHEMICAL APPARATUS:
ILLUSTRATED, CLASSIFIED, DESCRIPTIVE.
Demy 8vo., 480 pp., Illustrated with 1600 Woodcuts.
Most complete and cheapest List of Apparatus.

JOHN J. GRIFFIN and SONS, 22, Garrick Street,
London, W.C.

XOXHEAD'S FAT EXTRACTOR.

The most Accurate, Quickest, and Cheapest Form of Apparatus for this Work. Price 3s., unmounted. With Still and Condenser complete, 6s.

JOHN J. GRIFFIN and SONS, 22, Garrick Street,
London, W.C.

THE JOURNAL OF SCIENCE
for FEBRUARY (Price 1s. 6d.), includes—
The Early Practice of Medicine by Women. By Prof. H. Carrington Bolton, Ph.D.
Life and its Basis. By J. H. Barker, M.A.
The Formative Power in Nature. By Sidney Billing.
Experiments with the "Jnmpers" of Maiue. By George M. Beard, M.D.
A Defence of the Dog. By H. Bellyse Baildon.
A Safety Paper for Cheques.
Analyses of Books. Correspondence. Notes.
London: 3, Horse-Shoe Court, Ludgate Hill.

LIVERPOOL COLLEGE of CHEMISTRY,
LIVERPOOL.

FOUNDER—Dr. SHERIDAN MUSPRATT.
PRINCIPALS—Dr. TATE and GRANVILLE H. SHARPE.

Special advantages offered to Students. Assays, Analyses, and Chemical Investigations conducted.
For Prospectuses apply to the Principals.

SULPHUR.

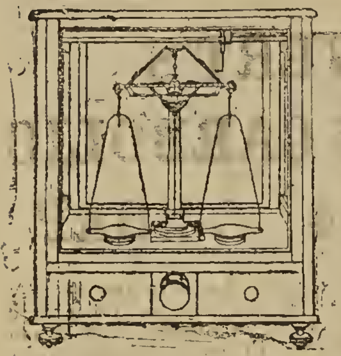
Wanted, to Buy Material Free from Arsenic, for making into Sulphuric Acid, by a large Vitriol Maker.—Address, C. H. L., CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.

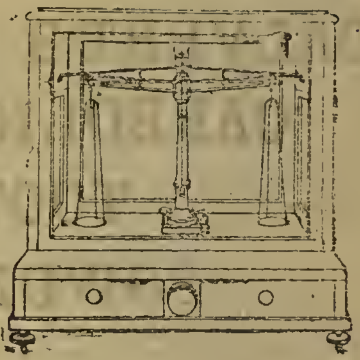
Working Manager Wanted by the Association of Chemical Manufacturers in Mannheim for one of their Manufactories of Mineral Acid and Soda.—Those thoroughly acquainted with the branch should apply by letter, stating full particulars and references, to the Direction des Vereins Chemischer Fabriken, in Mannheim.

CHEMICAL WORKS.

Manager Wanted, knowledge of Chemistry desirable but not essential. Preference to one having practical knowledge of tar products, of erection and maintenance of plant.—All particulars to M. C., CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.

PUREST DISTILLED WATER in London can be had at Excelsior Works, Wenlock Rd., City Rd., N.





ACTIEN-GESELLSCHAFT
FÜR
ANILIN-FABRIKATION,
BERLIN,

Manufacturers of Aniline Colours for Dyeing and Printing on Silk, Wool, Cotton, Leather, &c

WORKS—Rummelsburg and Wiesenufer, near Berlin.
OFFICES—Treptower Brücke, S.O.
TELEGRAM—"Anilin," Berlin.

MANUFACTURERS OF

RUBINES,	Engl. Patent, No. 243 (1878)	ACID YELLOW	Germ. Patent, No. 4186
ACID-RUBINE	,, ,, 2828 (1879)	MALACHITE GREENS,	Engl. Patent, No. 828 (1878)
PONCEAUS	,, ,, 1715 (1878)	ACID MALACHITE GREEN	,, ,, 4406 (1878)
BORDEAUX	,, ,, 1715 (1878)	BENZYLE BLUES	
PHOSPHINES		WATER BLUES	
MANDARINES			

Eosines
Rosaniline Base
Safranines
Coccines

Cotton Scarlets
Aurantia
Picric Acid
Methyl Orange

Bismarck Brown
Aniline Gray
Methyle Greens
Spirit Blue

Nigrosine
Coralline
Aurine
Martius Yellow
Berlin Brown
Regina Violet
Methyle Violets

Hofmann Violet
Marine Blue
Paper Blue
Mode Brown
Nacarate
Bavarian Blues
Night Blue

Humboldt Blue
Alkali (Nicholson) Blue
Guernsey Blue
Gentiana and Royal Blue)
and Gray Pastes
China Blue
Indigo Blue

ANILINE OILS
ANILINE SALTS IN CAKES AND CRYSTALS

MIRBANE OIL
METHYLE ANILINE

Samples and Prices on Application. *Special Terms to Merchants and Shippers.*

ALL GENUINE PACKAGES ARE PROTECTED BY TRADE-MARK.

⁂ Our Rubine (Magenta), and all Colours derived therefrom, are manufactured without employing Arsenic Acid.

WILLIAM AND WILLIAM T. FIELD,

MANUFACTURERS of the Celebrated STAFFORDSHIRE BLUE BRICKS, specially adapted for Chemical Plant, *i.e.*, Acid Towers, &c. Also all other kinds of Best Staffordshire Blue Bricks, Pavings, Plynths, Splays, Copings, &c. &c. Prices and samples on Application.

TESTIMONIAL

"We have used the Blue Staffordshire Brick or Sulphuric Acid Towers, &c., manufactured by Messrs. Field, for the last fifteen years during which time they have given great satisfaction. We recommend them to the Chemical Trade, believing there is nothing better in the market."—(Signed) WILLIAM HUNT and SONS, Lea Brook Alkali Works, near Wednesbury, Staffordshire, February, 1878.

TOLL END BRICK-WORKS,
TIPTON, STAFFORDSHIRE.

BISULPHIDE OF CARBON.

CHLORIDE OF SULPHUR.

GAS PURIFICATION & CHEMICAL CO., LIMITED,
61, 162, 163, PALMERSTON BUILDINGS, LONDON, E.C.

THOMAS ADKINS & CO.,
SMETHWICK,
NEAR BIRMINGHAM.

MANUFACTURERS OF SPECIALLY PREPARED RED LEAD FOR FLINT-GLASS MAKING.

FACTORIES.
Reddish and Bradford,
MANCHESTER.
BRONZE MEDAL, PARIS, 1867.

CHARLES LOWE & CO.,
(ESTABLISHED 1860.)

TOWN OFFICES:
61, Piccadilly,
MANCHESTER.
GOLD MEDAL, PARIS, 1878.

MANUFACTURERS OF

PURE CARBOLIC ACID, Cryst. at $42^{\circ}\cdot2$ C. } Discovered by C. Lowe
,, ,, do. Hydrate of
MEDICINAL do. Cryst. at 35° C.
COMMERCIAL do. No. 1 ,, 35° C.
,, do. 2 ,, 29° C.
,, do. 3 ,, 12° C.
,, do. 4 liquid at 0° C.
CARBOLIC ACID DISINFECTING POWDER.

CARBOLIC ACID GLYCERINE SOLUTIONS.
CRESYLIC ACID.
SULPHO-PHENIC ACID (CRYST.)
SULPHO-PHENATES & SULPHO-CRESYLATES OF SODA, POTASH, ZINC, IRON, and ALUMINA.

BENZOL (Cryst.).
ANTHRACENE.
NAPHTHALINE.
PICRIC ACID (Cryst. and Paste).
AURINE (Rosolic Acid) Cake and Solution.

JOHN CLIFF,
STONEWARE MANUFACTURER,

Late JOHN CLIFF & Co.
Formerly STEPHEN GREEN.
OF IMPERIAL POTTERIES,
LAMBETH.

OLD QUAY,
RUNCORN.

London: Printed and Published for the Proprietor by EDWIN JOHN DAVEY, at the Office, Boy Court, Ludgate Hill, E.C.
February 25, 1881.

SOCIETY
OF
GREAT BRITAIN

THE CHEMICAL NEWS AND JOURNAL OF PHYSICAL SCIENCE

Edited by
Wm. Crookes, F.R.S.

(WITH WHICH IS INCORPORATED THE "CHEMICAL GAZETTE")

Established
Thirty-Eight Years.

Vol. 43.—No. 1110.] Copyright reserved.

Friday, March 4, 1881.

Registered as a Newspaper. [PRICE, 4d. POST FREE, 4½d.

CONTENTS.

CAPPER PASS AND SON, BRISTOL,

ARE BUYERS OF

LEAD ASHES, SULPHATE OF LEAD,
LEAD SLAGS, ANTIMONIAL LEAD,
COPPER MATTE, TIN ASHES, &c.,
and DROSS or ORES containing
COPPER, LEAD, AND ANTIMONY.

A Chemist desires a Re-engagement. Has commercial experience, together with a knowledge of Mechanical Engineering, accustomed to conduct research, and would control whole or part of works or laboratory. Country preferred.—Address, C. A. 3, Deacon's Advertising Offices, Leadenhall Street, E.C.

Advertiser seeks Engagement as Assistant in Laboratory, or Chemist on Works, at home or abroad; well up in general analysis, also analysis under Food and Drugs Act; four years' experience.—Address, W. B., CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.

Advertiser, thoroughly conversant with Chemistry, Theoretical and Applied, experienced in O.V., Weldon, Deacon, Soda-ash, Crystals, Cream White, and 76 per cent Caustic Soda, &c. Could take the supervision of whole or part of works or laboratory, conduct research, and introduce improvements.—Address, Natrone, CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.

A Distinguished Chemist (Practical and Theoretical) desires co-operation of influential capitalists for the purpose of working some of his very important and highly valuable Inventions.—Address, in first instance, to N. Battersby, Solicitor, Manchester.

A Gentleman, with 8 years' experience, seeks an Appointment as Analytical Chemist in Works, or Assistant in a Laboratory. First class references.—Address, W., CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.

Analytical Chemist Wanted. Preference to one who has worked on Tar Products. Send age, salary, qualifications, and all particulars, to B. A., CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.

BRADY & MARTIN,
NEWCASTLE-ON-TYNE,

Will, on application, forward Catalogues of Chemical and Physical Apparatus, Pure Chemicals Special Reagent Bottles with Embossed Labels, Nitrometer, &c., &c.

GRIFFIN'S
CHEMICAL HANDICRAFT.
SECOND EDITION.
Price 4s. 7d. post free.

A CATALOGUE OF CHEMICAL APPARATUS:
ILLUSTRATED, CLASSIFIED, DESCRIPTIVE.
Demy 8vo., 480 pp., Illustrated with 1600 Woodcuts.
Most complete and cheapest List of Apparatus.

JOHN J. GRIFFIN and SONS, 22, Garrick Street,
London, W.C.

THE JOURNAL OF SCIENCE
for MARCH (Price 1s. 6d.), includes—

The Evolution of the Spheres. By Charles Morris.
Offensive Manufactures: A Suggestion. By An Old Technologist.
On Living Organisms with reference to Polluted Waters. By J. W. Slater.
The Inconceivable as a Test of Truth. By F. H. Nash.
Experiments with the "Jumpers" of Maine. By George M. Beard, M.D.
Analyses of Books. Correspondence. Notes.

London: 3, Horse-Shoe Court, Ludgate Hill.

DESTRUCTIVE DISTILLATION: A Manualette of the Paraffin, Coal-tar, Rosin, Oil, Petroleum, and kindred Industries. By EDMUND J. MILLS, D.Sc. (Lond.), F.R.S., "Young" Professor of Technical Chemistry in Anderson's College, Glasgow.

"Will be found useful by both students and manufacturers."—*English Mechanic.*

"In a small space conveys a great deal of useful information."—*Journal of Gas Lighting.*

London: VAN VOORST.

SULPHUR.

Wanted, to Buy Material Free from Arsenic, for making into Sulphuric Acid, by a large Vitriol Maker.—Address, C. H. L., CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.

Working Manager Wanted by the Association of Chemical Manufacturers in Mannheim for one of their Manufactories of Mineral Acid and Soda.—Those thoroughly acquainted with the branch should apply by letter, stating full particulars and references, to the Direction des Vereins Chemischer Fabriken, in Mannheim.

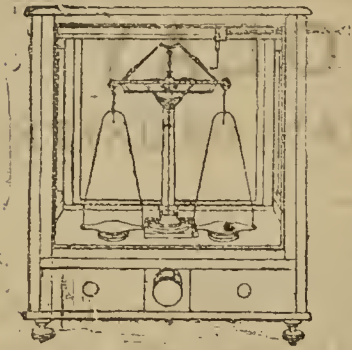
CHEMICAL WORKS.

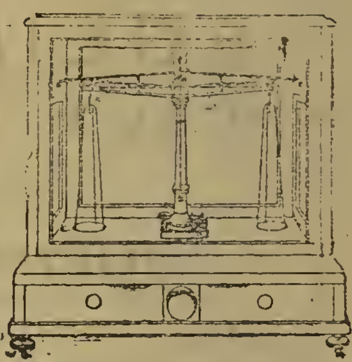
Manager Wanted, knowledge of Chemistry desirable but not essential. Preference to one having practical knowledge of tar products, of erection and maintenance of plant.—All particulars to M. C., CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.

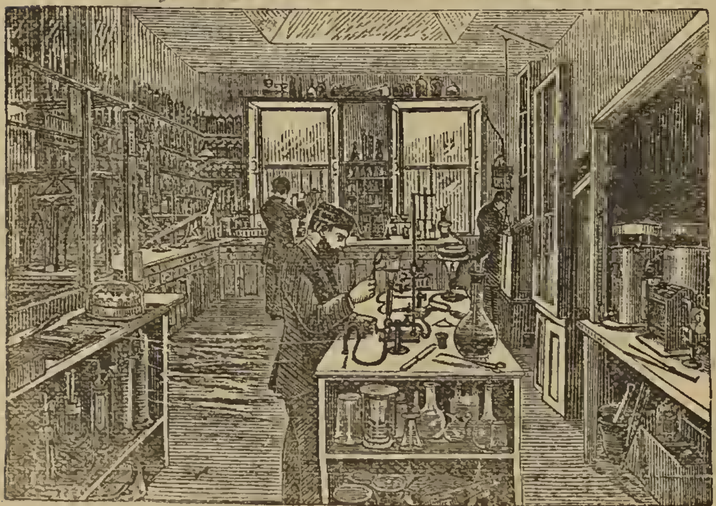
Partnership Wanted by a Manufacturer of Benzole, Nitro-Benzole, and Aniline; or would purchase Works and Plant suitable for carrying on the business.—Address, Nitro, CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.

CHEMICAL OR METALLURGICAL PARTNERSHIP.

An Assayer and Analytical Chemist of long standing and varied experience, with several thousand pounds. capital at his command, is desirous of obtaining a Partnership in London or the South in a first rate Assaying and Analytical Practice, or in an established Chemical Manufactory, in which his chemical knowledge and capital would be of service.—Address, Chemicus Box 36, Post Office, Middlesborough.







EGLINTON ALUM CLAY

(SIMILAR TO, BUT FREER FROM IRON THAN, BAUXITE).

THE EGLINTON CHEMICAL COMPANY, LIMITED, *who were the first to introduce this substance* to the notice of the Alum Trade, are now supplying it largely to ALUM MANUFACTURERS in this country and in America, Germany, and Russia, for the manufacture of Potash Alum and Sulphate of Alumina.

ANALYSIS OF DELIVERIES.

DRIED AT 212° F.

	First Quality.	Second Quality.
Alumina	52·37 per cent.	43·41 per cent.
Peroxide of Iron	1·29 ,,	1·81 ,,
Silica, &c.	19·24 ,,	34·35 ,,
Water of combination ...	27·13 ,,	20·52 ,,
	100·03	100·09

Being Shipowners, the EGLINTON CHEMICAL CO., LIM., can guarantee regular delivery as may be required, and are prepared to quote a price f.o.b. at their private Harbours at Glenarm and Ballintoy, or delivered at Buyers' Works, in bulk or in bags, ground or unground.

WILLIAM J. A. DONALD, *Secretary and Manager.*

29, ST. VINCENT PLACE, GLASGOW.

BECKER & SONS,

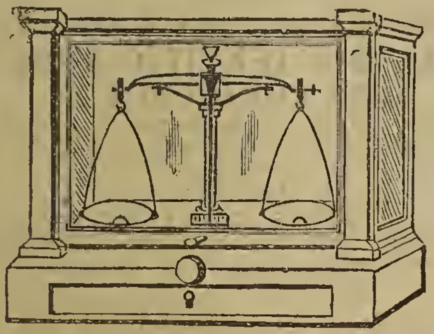
MANUFACTURERS OF

CHEMICAL AND GOLD ASSAY BALANCES

AND OTHER

SCALES AND WEIGHTS.

ROTTERDAM.



NEW YORK.

BECKER'S STUDENT'S BALANCE, in polished mahogany glass case, sliding front, counterpoised, to carry 30 grammes in each pan and turn to ½ milligramme, nickel plated pans £2 10

Ditto, ditto, in mahogany glass case, polished black.. .. .. £2 13

Sole Agents for England, Ireland, and Wales:—

TOWNSON & MERCER.

Becker's Complete Lists forwarded by post on receipt of 1*d*. stamp or free on application.

SOUTH LONDON CENTRAL PUBLIC LABORATORY.

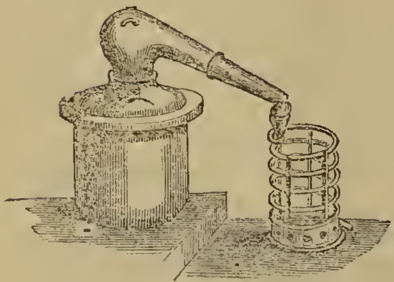
A Department has been opened for the Private Instruction of Gentlemen in Practical Chemistry as applied to any Special Industries or Commercial Products they may wish to study. For Fees, &c., apply to W. BAXTER, Secretary, Central Public Laboratory, Kennington Cross, S.E.

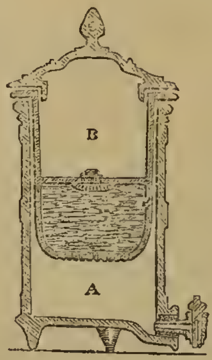
BISULPHIDE OF CARBON
PROTOSULPHATE
RED OXIDE
OXYCHLORIDE
Sulphocyanide,
And every other Mercurial Preparation,
BISULPHITE OF LIME, TETRACHLORIDE OF CARBON.
Oxysulphuret of Antimony, Glacial Acetic Acid,

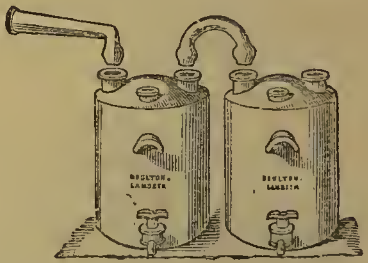
LIQUOR AMMONIÆ,
SULPHIDE OF IRON,
PURE ACIDS,
CHLORIDE OF SULPHUR,
ACETONE,
CHLOROFORM,
ALDEHYDE,
CHLORATE BARYTA,
ARSENIC ACIDS,
FRUIT ESSENCES FOR CONFECTIONERY & LIQUEURS,
PERCHLORIDE OF IRON,
SULPHITE AND HYPOSULPHITE OF SODA,
PHOSPHATES OF SODA AND AMMONIA,
ETHERS,
BROMIDES,
IODIDES,
SCALE AND GRANULAR PREPARATIONS,
SULPHIDE OF SODIUM.

ALSO,
Pure Photographic Chemicals of every kind.
MANUFACTURED BY
WILLIAM BAILEY & SON,
HORSELEY FIELDS CHEMICAL WORKS,
WOLVERHAMPTON.

SILICATE OF SODA, Solid and in Solutions of Various Degrees of Concentration: the finest quality obtainable, and especially adapted for the use of Soap Makers and other Consumers.—JOSEPH CROSFIELD and SONS, Soap Makers, &c., Warrington.
London Agent—H. F. CLARKE, Great Tower Street, E.C.







London: Printed and Published for the Proprietor by Edwin John Davey, at the Office, Boy Court, Ludgate Hil E.C. March 4. 1881.

THE

CHEMICAL NEWS

AND

JOURNAL OF PHYSICAL SCIENCE

Edited by Wm. Crookes, F.R.S. (WITH WHICH IS INCORPORATED THE "CHEMICAL GAZETTE") *Established Thirty-Eight Years.*

Vol. 43.—No. 1111. *Copyright reserved.* Friday, March 11, 1881. *Registered as a Newspaper.* Price, 4*d*. Post Free, 4½*d*.

CONTENTS.

CAPPER PASS AND SON, BRISTOL,
ARE BUYERS OF
LEAD ASHES, SULPHATE OF LEAD,
LEAD SLAGS, ANTIMONIAL LEAD,
COPPER MATTE, TIN ASHES, &c.,
and DROSS or ORES containing
COPPER, LEAD, AND ANTIMONY.

Advertiser seeks Engagement as Assistant in Laboratory, or Chemist on Works, at home or abroad; well up in general analysis, also analysis under Food and Drugs Act; four years' experience.—Address, W. B., Chemical News Office, Boy Court, Ludgate Hill, London, E.C.

A Distinguished Chemist (Practical and Theoretical) desires co-operation of influential capitalists for the purpose of working some of his very important and highly valuable Inventions.—Address, in first instance, to N. Battersby, Solicitor, Manchester.

A Gentleman, with 8 years' experience, seeks an Appointment as Analytical Chemist in Works, or Assistant in a Laboratory. First class references.—Address, W., Chemical News Office, Boy Court, Ludgate Hill, London, E.C.

A German Chemist, Ph.D., age 23, who has studied in the laboratories of Fresenius, Graebe, and Würtz, desires an engagement. Good analytical as well as general knowledge.—Address, P. R., 11, Clapton Square, Lower Clapton, E.

Wanted, for the Laboratory of a Chemical Works, near London. An Assistant Chemist. Salary £80 per Annum.—Apply, No. 666, Chemical News Office, Boy Court, Ludgate Hill, London, E.C.

Wanted, to Purchase Volumes 1, 3, 5, 6, and 7, of the 'Journal of the Chemical Society"; also Vol. 3 of the "Proceedings of the Royal Society."—Address, K. P. G., Chemical News Office, Boy Court, Ludgate Hill, London, E.C.

BRADY & MARTIN,
NEWCASTLE-ON-TYNE,
Will, on application, forward Catalogues of Chemical and Physical Apparatus, Pure Chemicals Special Reagent Bottles with Embossed Labels, Nitrometer, &c., &c.

GRIFFIN'S
CHEMICAL HANDICRAFT.
SECOND EDITION.
Price 4s. 7d. post free.

A CATALOGUE OF CHEMICAL APPARATUS:
ILLUSTRATED, CLASSIFIED, DESCRIPTIVE.
Demy 8vo., 480 pp., Illustrated with 1600 Woodcuts.
Most complete and cheapest List of Apparatus.

JOHN J. GRIFFIN and SONS, 22, Garrick Street, London, W.C.

THE JOURNAL OF SCIENCE
for MARCH (Price 1s. 6d.), includes—
The Evolution of the Spheres. By Charles Morris.
Offensive Manufactures: A Suggestion. By An Old Technologist.
On Living Organisms with reference to Polluted Waters. By J. W. Slater.
The Inconceivable as a Test of Truth. By F. H. Nash.
Experiments with the "Jumpers" of Maine. By George M. Beard, M.D.
Analyses of Books. Correspondence. Notes.
London: 3, Horse-Shoe Court, Ludgate Hill.

To BE SOLD, by Private Treaty, an OLD ESTABLISHED ALKALI WORKS in SOUTH-WEST LANCASHIRE, now working. The Plant is capable of producing weekly:—

200 Tons of Salt-Cake.
40 " Refined Salt-Cake.
40 " Soda-Ash.
50 " Caustic Soda.
60 " Bleaching-Powder.

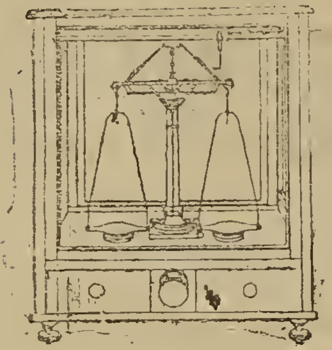
The works stand on about 19,000 square yards of land, which is held on lease for 999 years at a ground rent of £233 16s. per annum, and have an extensive Canal frontage and Railway Siding accommodation. They are surrounded by Collieries, from some of which fuel can be received without incurring Railway dues.

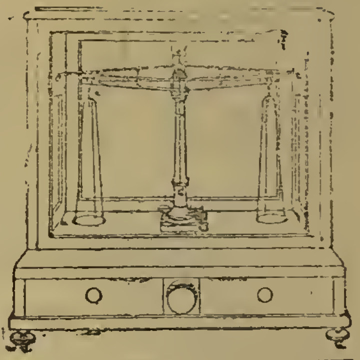
Apply to HARMOOD, BANNER, and SON,
24, North John Street,
Liverpool.

CITY OF LONDON FIRE INSURANCE COMPANY, LIMITED.
Offices, 101, Cheapside, London, E.C.
Applications for Agencies from Gentlemen of position and influence are invited from all the principal Cities and Towns in the United Kingdom.—Address, with full particulars,—
THE MANAGER.

SULPHUR.
Wanted, to Buy Material Free from Arsenic, for making into Sulphuric Acid, by a large Vitriol Maker.—Address, C. H. L., Chemical News Office, Boy Court, Ludgate Hill, London, E.C.

CHEMICAL OR METALLURGICAL PARTNERSHIP.
An Assayer and Analytical Chemist of long standing and varied experience, with several thousand pounds capital at his command, is desirous of obtaining a Partnership in London or the South in a first rate Assaying and Analytical Practice, or in an established Chemical Manufactory, in which his chemical knowledge and capital would be of service.—Address, Chemicus Box 36, Post Office, Middlesborough.





EGLINTON ALUM CLAY

(SIMILAR TO, BUT FREER FROM IRON THAN, BAUXITE).

THE EGLINTON CHEMICAL COMPANY, LIMITED, *who were the first to introduce this substance* to the notice of the Alum Trade, are now supplying it largely to ALUM MANUFACTURERS in this country and in America, Germany, and Russia, for the manufacture of Potash Alum and Sulphate of Alumina.

ANALYSIS OF DELIVERIES.

	DRIED AT 212° F.	
	First Quality.	Second Quality.
Alumina	52·37 per cent.	43·41 per cent.
Peroxide of Iron	1·29 ,,	1·81 ,,
Silica, &c.	19·24 ,,	34·35 ,,
Water of combination ...	27·13 ,,	20·52 ,,
	100·03	100·09

Being Shipowners, THE EGLINTON CHEMICAL CO., LIM., can guarantee regular delivery as may be required, and are prepared to quote a price f.o.b. at their private Harbours at Glenarm and Ballintoy, or delivered at Buyers' Works, in bulk or in bags, ground or unground.

WILLIAM J. A. DONALD, *Secretary and Manager.*

29, ST. VINCENT PLACE, GLASGOW.

ESTABLISHED 1798.

ROBERT DAGLISH & CO.,

ENGINEERS, BOILER AND BRIDGE MAKERS, MILLWRIGHTS, BRASS AND IRON FOUNDERS.

Manufacturers of every description of Condensing, or High-pressure Blowing, Pumping, Rolling, Winding, and Patent Steam-engines, of any required power, for Irrigating, Draining, Mining, Rolling Mills, or Water Works purposes, and Manufacturers of every description of Chemical, Colliery, Copper Ore, Gold Mining, Glass, and Rock-salt Machinery.

Black-ash Revolving Furnaces of the Most Approved Type.

Bessemer Steel-Rail Plant.

Compressing-Engines for Collieries, Iron Works, and Weldon's Patent Bleaching-Powder Process.

Caustic, Chlorate, Decomposing, Nitre Nitro-Glycerine, Iodine Potash, Sulphur, Acid, and Oxalic Pans.

Gas Producers Patent for Heating and other Purposes.

Pyrites Burners for Irish, Norwegian, and Spanish Ores of Improved Construction.

Patent Rousing Machinery for Brewers.

Retorts, Acid, Gas, Iodine, Nitric, Nitre Nitro-Glycerine and Vitriol Refining.

Steam Superheaters improved for Oil, Tar, and Resin Refining.

Steam Sulphur Melter.

Stills for Oil, Resin, and Tar.

Wheels, Bevel, Mitre, and Spur Moulded on the Shortest Notice by Patent Machinery.

Makers of Mactear's Patent Carbonating Furnace, Jones and Walsh's Patent Sulphate of Soda Furnace, Parnell and Simpson's Patent Causticiser, and Kynaston's Patent Alum Plan

Lists sent on Application.

Photographs, Plans, and other information supplied on receipt of Order.

ST HELEN'S ENGINE, BOILER, AND BRIDGE WORKS AND FOUNDRY,
LANCASHIRE.

DIAM. OF RAM INS.	1¼	1½	1¾	2	2¼	2½	3	3½	4
PRICE	24/6	37/6	45/	50/	55/	63/	78/	90/	127/
IF WITH GUN METAL PLUNGER	40/	55/	70/	90/	110/	150/	200/	250/	[illegible]

BAILEY'S WATER MOTORS.

BAILEY'S HYDRAULIC LIFTS.

BAILEY'S INJECTORS.

Albion Works, Salford, Manchester.

ROYAL POLYTECHNIC.—The Photophone, popularly explained and illustrated by experiments. The Great Lightning Inductorium; a Popular Astronomical Lecture, illustrated by beautiful Dissolving Views and Effects, &c., by Mr. J. L. King. Musical Sketches of a high and amusing order, by Mr. Eric Lewis. Magical Art in Perfection, by Prof. R. Hellis. Costume Recitals, by Madame Katharine Hickson. Electric Railway. Leotard and Blondin, the Wonderful Automata. Diving Bell, &c. Admission to the whole, 1s. Open from 12 till 5, and from 7 till 10.

London: Printed and Published for the Proprietor by EDWIN JOHN DAVEY, at the Office, Boy Court, Ludgate Hill, E.C.
March 11, 1881.

THE

CHEMICAL NEWS

AND

JOURNAL OF PHYSICAL SCIENCE

Edited by Wm. Crookes, F.R.S. (WITH WHICH IS INCORPORATED THE "CHEMICAL GAZETTE") Established Thirty-Eight Years.

Vol. 43.—No. 1112. Copyright reserved. Friday, March 18, 1881. Registered as a Newspaper. PRICE, 4d. POST FREE, 4½d.

CONTENTS.

ARTICLES:— PAGE

CAPPER PASS AND SON, BRISTOL,

ARE BUYERS OF

LEAD ASHES, SULPHATE OF LEAD,
LEAD SLAGS, ANTIMONIAL LEAD,
COPPER MATTE, TIN ASHES, &c.,
and DROSS or ORES containing
COPPER, LEAD, AND ANTIMONY.

Analytical Assistant required by a Firm of Manufacturing Chemists. State age, qualifications, previous experience, and salary required.—Address, F. G. R., 243, Evering Road, Upper Clapton, London.

A Chemist desires a Re-engagement. Has commercial experience, together with a knowledge of Mechanical Engineering, accustomed to conduct research, and would control whole or part of works or laboratory. Country preferred.—Address, C. A., 3, Deacon's Advertising Offices, Leadenhall Street, E.C.

Advertiser seeks Engagement as Assistant in Laboratory, or Chemist on Works, at home or abroad; well up in general analysis, also analysis under Food and Drugs Act; four years' experience.—Address, W. B., CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.

A Distinguished Chemist (Practical and Theoretical) desires co-operation of influential capitalists for the purpose of working some of his very important and highly valuable Inventions.—Address, in first instance, to N. Battersby, Solicitor, Manchester.

A Gentleman, with 8 years' experience, seeks an Appointment as Analytical Chemist in Works, or Assistant in a Laboratory. First class references.—Address, W., CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.

Wanted, for the Laboratory of a Chemical Works, near London. An Assistant Chemist. Salary £80 per Annum.—Apply, No. 666, CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.

Wanted, an Agent who calls on Chemical Manufacturers, to represent a New Invention, on Commission. —Address, B. and Co., Albion Works, Salford, Manchester.

BRADY & MARTIN,
NEWCASTLE-ON-TYNE,

Will, on application, forward Catalogues of Chemical and Physical Apparatus, Pure Chemicals Special Reagent Bottles with Embossed Labels, Nitrometer, &c., &c.

GRIFFIN'S
CHEMICAL HANDICRAFT.
SECOND EDITION.
Price 4s. 7d. post free.

A CATALOGUE OF CHEMICAL APPARATUS:
ILLUSTRATED, CLASSIFIED, DESCRIPTIVE.
Demy 8vo., 480 pp., Illustrated with 1600 Woodcuts.
Most complete and cheapest List of Apparatus.

JOHN J. GRIFFIN and SONS, 22, Garrick Street, London, W.C.

THE JOURNAL OF SCIENCE
for MARCH (Price 1s. 6d.), includes—

The Evolution of the Spheres. By Charles Morris.
Offensive Manufactures: A Suggestion. By An Old Technologist.
On Living Organisms with reference to Polluted Waters. By J. W. Slater.
The Inconceivable as a Test of Truth. By F. H. Nash.
Experiments with the "Jumpers" of Maine. By George M. Beard, M.D.
Analyses of Books. Correspondence. Notes.

London: 3, Horse-Shoe Court, Ludgate Hill.

CITY OF LONDON FIRE INSURANCE
COMPANY, LIMITED.

OFFICES, 101, CHEAPSIDE, LONDON, E.C.

Applications for Agencies from Gentlemen of position and influence are invited from all the principal Cities and Towns in the United Kingdom.—Address, with full particulars,—
THE MANAGER.

CHEMICAL OR METALLURGICAL PARTNERSHIP

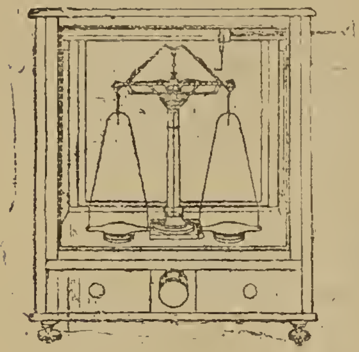
An Assayer and Analytical Chemist of long standing and varied experience, with several thousand pounds capital at his command, is desirous of obtaining a Partnership in London or the South in a first rate Assaying and Analytical Practice, or in an established Chemical Manufactory, in which his chemical knowledge and capital would be of service.—Address, Chemicus Box 36, Post Office, Middlesborough.

A First Class House in the Drug, &c., Trade, Established in Rhenish Prussia (Germany), wishes to undertake a Main Depot, or the exclusive sale of a suitable article, even if a speciality and not yet introduced.—Address, B. S., 85, care of Messrs. Haasenstein and Vogler, Cologne.

First Class Certificated Student in Practical and Theoretical Chemistry, desires to article himself to Proprietors of Chemical or other Works. Would give services for a time, or small premium. Excellent references of character. Age 24. —Address, A. C. J., CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.

Wanted, in a Chemical Works, a Chemist, who has had experience in the Manufacture of Alkali, including high strength caustic, and in the sulphur recovery process.—Address, CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.

Wanted, to Purchase Volumes 1, 3, 5, 6, and 7, of the 'Journal of the Chemical Society"; also Vol. 3 of the "Proceedings of the Royal Society."—Address, K. P. G., CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.



L. OERTLING,

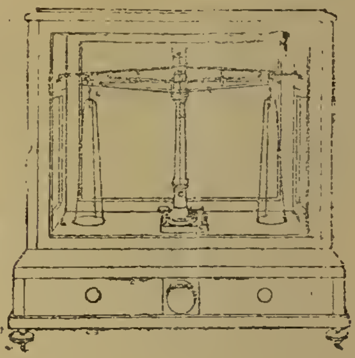
TURNMILL STREET
(OPPOSITE FARRINGDON STREET) STATION.

MANUFACTURER OF

CHEMICAL, ASSAY, & BULLION BALANCES.

Maker to the Bank of England, Assay Office
of the Royal Mint, &c., &c.

By Appointment.



COUNCIL MEDAL, 1851. FIRST CLASS MEDAL, 1854 and 1862.

BISULPHITE OF LIME.
BISULPHITE OF SODA.
SULPHITE OF SODA. TANNATE OF SODA

WILLIAM MARRIOTT
HEMICAL WORKS HUDDERSFIELD

TETRACHLORIDE OF CARBON.
BISULPHIDE OF CARBON.
CHLORIDE OF SULPHUR.

JESSE FISHER & SON,
Phœnix Chemical Works Ironbridge.

UNIVERSAL

FILTER-PRESSES WITH FRAMES,

THE BEST FILTER-PRESS ON THE MARKET,
OF

1300 Filter presses in use.

WEGELIN & HÜBNER, HALLE ON SAALE, GERMANY,

1300 Filter presses in use

ENGINEERS AND IRONFOUNDERS.

Made in Wood, Iron, Bronze, or Lead, for the Filtration or Separation of Liquids from Solid Matters, with or without attachment, for the perfect washing of the latter.

MAWSON & SWAN,

LABORATORY OUTFITTERS,

IMPORTERS & MAKERS OF PHILOSOPHICAL INSTRUMENTS
CHEMICAL, ELECTRICAL, AND OTHER APPARATUS.

MAWSON & SWAN have an extensive assortment of all kinds of Chemical and Scientific Apparatus, Pure Chemicals, and Reagents.

Sole Agents for the sale of Bunge's *Celebrated Balances and Weights of Precision.*

13 & 15, MOSLEY STREET,
NEWCASTLE-ON-TYNE.

TOWNSON & MERCER,

89, Bishopsgate Street Within,
LONDON.

Wholesale and Export Dealers and Manufacturers of

CHEMICAL & SCIENTIFIC APPARATUS,
PURE CHEMICALS, &c.,

For Analysis and the general Laboratory Use of Manufacturers and Professors of Universities, Schools, Mines, &c.

Now ready,

TOWNSON & MERCER'S COMPLETE CATALOGUE of Chemical and Scientific Instruments, Pure Chemicals &c. Demy 8vo. Illustrated with upwards of 800 Woodcuts. Price 2s. 6d., post free.

Silicates of Soda and Potash in the state of Soluble Glass, or in CONCENTRATED SOLUTION of first quality, suited for the Manufacture of Soap and other purposes, supplied on best terms by W GOSSAGE and Sons, Soap Works, Widnes, Lancashire.

London Agents, COSTE and Co., 19 and 20, Water Lane, Tower Street, E.C., who hold stock ready for delivery

---

MOTTERSHEAD & CO.,

7, Exchange Street and 10, Half Moon Street,
MANCHESTER.

CHEMICAL & PHYSICAL APPARATUS,
BOTTLES, PURE CHEMICALS,
REAGENTS, STANDARD SOLUTIONS,
And Every Requirement for Works' or School Laboratories or Private Students.

Illustrated Price Lists on application.

YOUNG'S PARAFFIN LIGHT & MINERAL OIL CO., LIMITED.

The Directors of this Company are prepared to receive TENDERS for the supply of the GENERAL STORES required at their ADDIEWELL, BATHGATE, and BIRMINGHAM WORKS, and also at all their PITS, for the YEAR ENDING 30th APRIL, 1882, as under:—

Class No.
1. Bolts, Nuts, and Rivets
45. Brass, &c.
2. Bricks, Clay, &c.
3. Brushes and Mops
4. Candle Boxes—Pasteboard
5. Canvas
47. Casks, &c.
6. Cast Iron Castings
7. Chemical Apparatus
8. Cloths, Plaiding, &c.
9. Colours.
10. Corks
16. Drysalteries
17. Gas and Water Fittings
18. Glass Chimneys
19. Grease, Soap, and Tallow
20. Gun Metal
21. Hardware and Sundries

Class No.
22. India Rubber, &c.
44. Japanning and Bronzing Materials
23. Lamp Burners, &c.
24. Lamp Founts and Hand Lamps
26. Leather
27. Nails, Screws, &c.
48. Pig Iron
32. Reflectors
29. Ropes, &c.
30. Shades, Moons, &c.
37. Timber
33. Tin, Lead, &c.
40. Tools
35. Wicks—Candle and Lamp
41. Wire Ropes
49. Wooden Handles, &c.

Detailed Specifications and Forms of Tender, and any other necessary information, may be obtained, on and after Monday, 14th current, at the Company's Registered Office, 7, West George Street, Glasgow.

Patterns of the General Stores may be seen at the Company's Addiewell Works, near Westcalder; and Patterns of Lamp Fittings at their Clissold Works, New Spring Street, Birmingham.

Tenders, endorsed "TENDER FOR STORES," to be lodged with the undersigned, on or before Wednesday, 30th current.

The Directors do not bind themselves to accept the lowest or any offer.

JOHN FYFE, General Manager.

Merchants' House Buildings,
7, West George Street,
Glasgow, 9th March, 1881.

MR. J. S. MERRY,

ASSAYER AND ANALYTICAL CHEMIST,
SWANSEA.

ESTABLISHED 1798.

ROBERT DAGLISH & CO.,

ENGINEERS, BOILER AND BRIDGE MAKERS, MILLWRIGHTS,

BRASS AND IRON FOUNDERS.

Manufacturers of every description of Condensing, or High-pressure Blowing, Pumping, Rolling, Winding, and Patent Steam-engines, of any required power, for Irrigating, Draining, Mining, Rolling Mills, or Water Works purposes, and Manufacturers of every description of Chemical, Colliery, Copper Ore, Gold Mining, Glass, and Rock-salt Machinery.

Black-ash Revolving Furnaces of the Most Approved Type.

Bessemer Steel-Rail Plant.

Compressing-Engines for Collieries, Iron Works, and Weldon's Patent Bleaching-Powder Process.

Caustic, Chlorate, Decomposing, Nitre Nitro-Glycerine, Iodine Potash, Sulphur, Acid, and Oxalic Pans.

Gas Producers Patent for Heating and other Purposes.

Pyrites Burners for Irish, Norwegian, and Spanish Ores of Improved Construction.

Patent Rousing Machinery for Brewers.

Retorts, Acid, Gas, Iodine, Nitric, Nitre Nitro-Glycerine and Vitriol Refining.

Steam Superheaters improved for Oil, Tar, and Resin Refining.

Steam Sulphur Melter.

Stills for Oil, Resin, and Tar.

Wheels, Bevel, Mitre, and Spur Moulded on the Shortest Notice by Patent Machinery.

Makers of Mactear's Patent Carbonating Furnace, Jones and Walsh's Patent Sulphate of Soda Furnace, Parnell and Simpson's Patent Causticiser, and Kynaston's Patent Alum Plan

Lists sent on Application.

Photographs, Plans, and other information supplied on receipt of Order.

ST HELEN'S ENGINE, BOILER, AND BRIDGE WORKS AND FOUNDRY,
LANCASHIRE.

WILLIAM AND WILLIAM T. FIELD,

MANUFACTURERS of the Celebrated STAFFORDSHIRE BLUE BRICKS, specially adapted for Chemical Plant, *i.e.*, Acid Towers, &c. Also all other kinds of Best Staffordshire Blue Bricks, Pavings, Plynths, Splays, Copings, &c. &c. Prices and samples on Application.

TESTIMONIAL

"We have used the Blue Staffordshire Brick or Sulphuric Acid Towers, &c., manufactured by Messrs. Field, for the last fifteen years during which time they have given great satisfaction. We recommend them to the Chemical Trade, believing there is nothing better in the market."—(Signed) WILLIAM HUNT and SONS, Lea Brook Alkali Works, near Wednesbury, Staffordshire, February, 1878.

TOLL END BRICK-WORKS,
TIPTON, STAFFORDSHIRE.

These Pumps are especially adapted for MINES, QUARRIES, DYE WORKS, BREWERIES, &c.

They are so simple in construction that repairs can be done by an ordinary mechanic.

ROYAL POLYTECHNIC.—The Photophone, popularly explained and illustrated by experiments. The Great Lightning Inductorium; a Popular Astronomical Lecture. illustrated by beautiful Dissolving Views and Effects, &c., by Mr. J. L. King. Musical Sketches of a high and amusing order, by Mr. Eric Lewis. Magical Art in Perfection, by Prof. R. Hellis. Costume Recitals, by Madame Katharine Hickson. Electric Railway. Leotard and Blondin, the Wonderful Automata. Diving Bell, &c. Admission to the whole, 1s. Open from 12 till 5, and from 7 till 10.

BERNERS COLLEGE of CHEMISTRY.

Instruction and preparation in CHEMISTRY and the EXPERIMENTAL SCIENCES under the direction of Professor E. V. GARDNER, F.A.S., M.S.A.

The Class Rooms are open from 11 to 5 a.m. and from 7 to 10 p.m daily.

Especial facilities or persons preparing for Government and other examinations.

Private Pupils will find every convenience.

Analyses, Assays, and Practical Investigations connected with Patents, &c., conducted.

Prospectuses and full particulars on application to Prof Gardner at Berners College, 44, Berners-street W.

THE CHEMICAL NEWS
AND
JOURNAL OF PHYSICAL SCIENCE.

Edited by WILLIAM CROOKES, F.R.S.

Published every Friday. Price 4d. Annual Subscription, post free including Indices, £1

CHARGES FOR ADVERTISEMENTS.

	£	s.	d.
Five lines in column (about 10 words to line)	0	3	6
Each additional line	0	0	6
Whole column	1	15	0
Whole page	3	0	0

A reduction made for a series of insertions.

Cheques and Post-Office Orders, crossed "London and County Bank," payable to the order of William Crookes.

BOY COURT LUDGATE HILL LONDON, E.C.

EGLINTON ALUM CLAY

(SIMILAR TO, BUT FREER FROM IRON THAN, BAUXITE).

THE EGLINTON CHEMICAL COMPANY, Limited, *who were the first to introduce this substance* to the notice of the Alum Trade, are now supplying it largely to Alum Manufacturers in this country and in America, Germany, and Russia, for the manufacture of Potash Alum and Sulphate of Alumina.

ANALYSIS OF DELIVERIES.

	Dried at 212° F.	
	First Quality.	Second Quality.
Alumina	52·37 per cent.	43·41 per cent.
Peroxide of Iron	1·29 ,,	1·81 ,,
Silica, &c.	19·24 ,,	34·35 ,,
Water of combination ...	27·13 ,,	20·52 ,,
	100·03	100·09

Being Shipowners, THE EGLINTON CHEMICAL CO., Lim., can guarantee regular delivery as may be required, and are prepared to quote a price f.o.b. at their private Harbours at Glenarm and Ballintoy, or delivered at Buyers' Works, in bulk or in bags, ground or unground.

WILLIAM J. A. DONALD, *Secretary and Manager.*

29, St. Vincent Place, Glasgow.

IRISH HILL BAUXITE (Alum Clay).

The IRISH HILL MINING CO. are now, and always have been, the LARGEST PRODUCERS OF THIS CLAY, of Superior Quality, and supply the Manufacturers of Alum, Sulphate of Alumina, and Alum-Cake, of the United Kingdom, America, and the Continent, almost exclusively.

Analysis by John Pattinson, Esq.

	Dried at 212° F.		
	Gertrude.	1st Quality.	2nd Quality.
Alumina	59·00	53·83	52·00
Peroxide of Iron	0·47	1·57	4·57
Silica	18·00	8·67	12·00
Titanic Acid		5·80	6·20
Lime, Magnesia, Potash, Soda, and Sulphuric Acid	0·23	0·83	1·14
Combined Water	22·30	29·27	24·00
	100·00	99·97	99·91

Our MINES, DRYING KILNS, and GRINDING MILLS are situated very close to the Shipping Ports of BELFAST and LARNE, and adjacent to Railways running alongside both Steamers and Sailing Vessels at both Ports, from either of which shipping is abundant and cheap, therefore we can guarantee Regular Delivery as Buyers require it, and are prepared to quote prices f.o.b. c.i.f., or delivered at any Port, in Bulk or Bags, Lump or Ground.

GEO. G. BLACKWELL, *Managing Director.*

Richmond Buildings, 26, Chapel St.,
Liverpool.

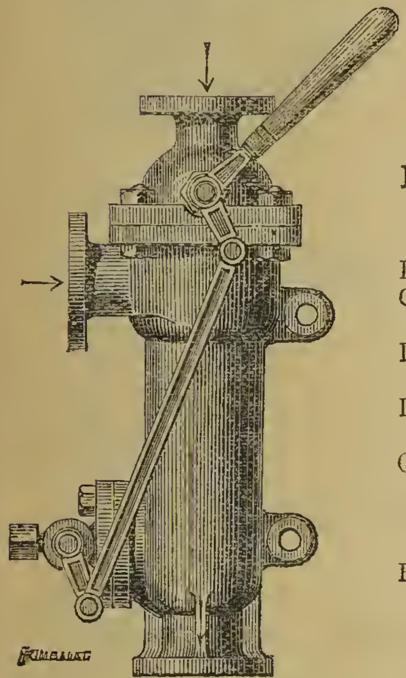
KÖRTING BROTHERS,

ENGINEERS,

17, LANCASTER AVENUE, FENNEL STREET,

MANCHESTER.

E. KÖRTING'S Patent Universal Injector



Works equally well non-lifting or lifting. Can be made to lift 26 ft. Works with high or low steam pressure. Works with hot or cold water. Forces the water into the boiler considerably above boiling point, thereby increasing the durability of the boiler.

IS STARTED BY SIMPLY TURNING ONE LEVER.

SUPPLIED TO:—

Belfast.	Corporation Gas Works
Church.	Foxhillbank Printing Co.
Deptford.	Mr. A. J. Dickinson.
,,	R. Wheen & Sons.
Dublin.	A. Guinness, Sons, & Co.
Glasgow.	Lloyd's Proving House.
,,	P. & W. McClellan.
,,	A. Stephens & Sons.
,,	Stevenson & Co.
Hebburn.	Tharsis Sulphur Co.
Leeds.	Corporation Gas Works.
Lincoln.	Messrs. Robey & Co.
London.	May & Baker.
,,	Merryweather & Sons.
,,	Victoria Graving Dock Co.
Polmont.	Nobel's Explosive Co., Lim.
Sittingbourne.	Mr. E. Lloyd.
Sunderland.	The Ford Works Co.
Wakefield.	Gas Co.
Widnes.	Jas. Muspratt & Sons.

Price Lists and Testimonials on Application.

BECKER & SONS,

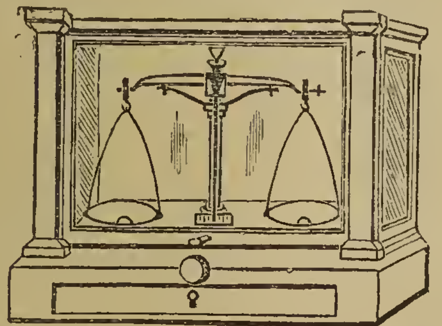
MANUFACTURERS OF

CHEMICAL AND GOLD ASSAY BALANCES

AND OTHER

SCALES AND WEIGHTS.

ROTTERDAM. NEW YORK.



BECKER'S STUDENT'S BALANCE, in polished mahogany glass case, sliding front, counterpoised, to carry 30 grammes in each pan and turn to ½ milligramme, nickel plated pans £2 10

Ditto, ditto, in mahogany glass case, polished black.. .. .. £2 13

Sole Agents for England, Ireland, and Wales:—

TOWNSON & MERCER.

Becker's Complete Lists forwarded by post on receipt of 1*d.* stamp or free on application.

SOUTH LONDON CENTRAL PUBLIC LABORATORY.

A Department has been opened for the Private Instruction of Gentlemen in Practical Chemistry as applied to any Special Industries or Commercial Products they may wish to study. For Fees, &c., apply to W. Baxter, Secretary, Central Public Laboratory, Kennington Cross, S.E.

BISULPHIDE OF CARBON

PROTOSULPHATE

RED OXIDE

OXYCHLORIDE

Sulphocyanide,

And every other Mercurial Preparation.

BISULPHITE OF LIME, TETRACHLORIDE OF CARBON.

Oxysulphuret of Antimony, Glacial Acetic Acid,

Liquor Ammoniæ,
Sulphide of Iron,
Pure Acids,
Chloride of Sulphur,
Acetone,
Chloroform,
Aldehyde,
Chlorate Baryta,
Arsenic Acids,
Fruit Essences for Confectionery & Liqueurs,
Perchloride of Iron,
Sulphite and Hyposulphite of Soda,
Phosphates of Soda and Ammonia,
Ethers,
Bromides,
Iodides,
Scale and Granular Preparations,
Sulphide of Sodium.

ALSO,

Pure Photographic Chemicals of every kind.

MANUFACTURED BY

WILLIAM BAILEY & SON,

HORSELEY FIELDS CHEMICAL WORKS,
WOLVERHAMPTON.

SILICATE OF SODA, Solid and in Solutions of Various Degrees of Concentration: the finest quality obtainable, and especially adapted for the use of Soap Makers and other Consumers.—JOSEPH CROSFIELD and SONS, Soap Makers, &c., Warrington.

London Agent—H. B. CLARKE, Great Tower Street, E.C.

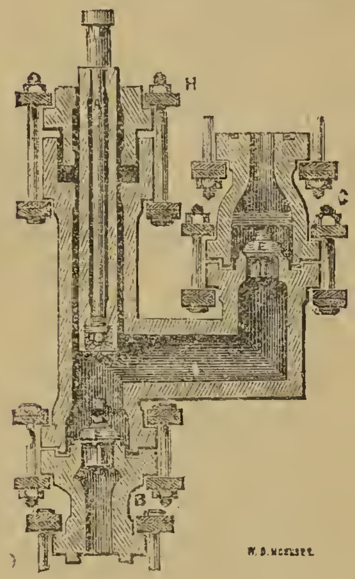
DOULTON & WATTS

HIGH STREET, LAMBETH, LONDON, S.E.

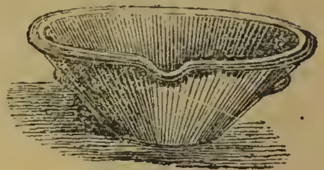
MANUFACTURERS OF

STILLS, RETORTS, CONDENSING WORMS, WOLFF'S BOTTLES,
ACID PUMPS, COCKS, PERCOLATORS, AIR-TIGHT JARS

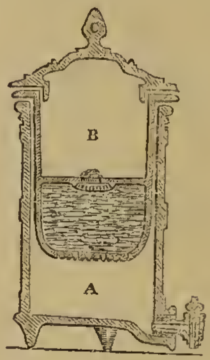
And every description of Stoneware for Chemical Purposes,
warranted to resist the strongest acids.



PLUMBAGO CRUCIBLES AND OTHER
FIRE-STANDING GOODS.



DOULTONS' MANGANOUS



CARBON FILTER.

(Dr. Bernays's Patent).

The Patent Manganous Carbon Filter combines important improvements in construction which have been effected by Messrs. Doulton & Co., in conjunction with a valuable discovery made by Dr Bernays, Professor of Chemistry at St. Thomas's Hospital; Public Analyst; Chemist to the Kent Water Works, &c., &c., &c.

NEW SHOW ROOMS, ALBERT EMBANKMENT, LAMBETH, S.E.
Depots:—Wood St., Birmingham; 100, Soho St., Liverpool; and 6, Rue de Paradis Poissonière, Paris.

Sulphate of Alumina

(CONCENTRATED ALUM),

Of the Richest and Purest Quality Produced in Great Britain.

MANUFACTURED UNDER CHADWICK'S AND KYNASTON'S PATENTS
BY THE

ST. HELENS CHEMICAL CO.,
ST. HELENS,
LANCASHIRE.

BISULPHIDE OF CARBON.
CHLORIDE OF SULPHUR.

GAS PURIFICATION & CHEMICAL CO., LIMITED,
161, 162, 163, Palmerston Buildings, London, E.C.

THOMAS ADKINS & CO.,
SMETHWICK,
NEAR BIRMINGHAM

Manufacturers of Specially Prepared Red Lead for Flint-Glass Making.

FACTORIES.
Reddish and Bradford,
MANCHESTER.
BRONZE MEDAL, PARIS, 1867.

CHARLES LOWE & CO.,
(Established 1860.)

TOWN OFFICES:
43 Piccadilly,
MANCHESTER.
GOLD MEDAL PARIS, 1878.

MANUFACTURERS OF

Pure Carbolic Acid, Cryst. at 42°·2 C. } Discovered by C. Lowe
" " do. Hydrate of
Medicinal do. Cryst. at 35° C.
Commercial do. No. 1 " 35° C.
" do. 2 " 29° C.
" do. 3 " 12° C.
" do. 4 liquid at 0° C.
Carbolic Acid Disinfecting Powder.

Carbolic Acid Glycerine Solutions.
Cresylic Acid.
Sulpho-Phenic Acid (Cryst.)
Sulpho-Phenates & Sulpho-Cresylates of Soda, Potash, Zinc, Iron, and Alumina.

Benzol (Cryst.).
Anthracene.
Naphthaline.
Picric Acid (Cryst. and Paste).
Aurine (Rosolic Acid) Cake and Solution.

JOHN CLIFF,
STONEWARE MANUFACTURER,

Late JOHN CLIFF & Co.
Formerly STEPHEN GREEN.
IMPERIAL POTTERIES,
LAMBETH.

OLD QUAY,
RUNCORN.

London: Printed and Published for the Proprietor by Edwin John Davey, at the Office, Boy Court, Ludgate Hill, E.C.
March 18, 1881.

THE

CHEMICAL NEWS

AND

JOURNAL OF PHYSICAL SCIENCE

Edited by Wm. Crookes, F.R.S.] (WITH WHICH IS INCORPORATED THE "CHEMICAL GAZETTE") [Established Thirty-Eight Years.

Vol. 43.—No. 1113.] *Copyright reserved.* Friday, March 25, 1881. *Registered as a Newspaper.* [PRICE, 4d. POST FREE, 4½d.

CONTENTS.

CAPPER PASS AND SON, BRISTOL,

ARE BUYERS OF

LEAD ASHES, SULPHATE OF LEAD,
LEAD SLAGS, ANTIMONIAL LEAD,
COPPER MATTE, TIN ASHES, &c.,
and DROSS or ORES containing
COPPER, LEAD, AND ANTIMONY.

TO COLOUR OR ORGANIC MANUFACTURING CHEMISTS.

A Chemist—first-class organic and inorganic certificates—passed Chemical Institute practical examination—worked at colours nearly two years—four years' business experience—desires position as Chemist on Works.—Address, "Diazo," CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.

A Chemist, who has had six months' practical work as Junior Assistant in the Laboratory of a well-known Public Analyst, desires a Re-engagement.—J. W., 1, Dermoth's Rd., Lewisham, London, S.E.

Advertiser seeks Engagement as Assistant in Laboratory, or Chemist on Works, at home or abroad; well up in general analysis, also analysis under Food and Drugs Act; four years' experience.—Address, W. B., CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.

A Distinguished Chemist (Practical and Theoretical) desires co-operation of influential capitalists for the purpose of working some of his very important and highly valuable Inventions.—Address, in first instance, to N. Battersby, Solicitor, Manchester.

A Gentleman, with 8 years' experience, seeks an Appointment as Analytical Chemist in Works, or Assistant in a Laboratory. First class references.—Address, W., CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.

A Young Man, aged 20, with a knowledge of Analysis and Practical Chemistry, for which he possesses two certificates, seeks Employment in a manufacturing or other concern. Good references.—Please address, D. L., care of C. G. Malone, Ormond Quay, Dublin.

BRADY & MARTIN,
NEWCASTLE-ON-TYNE,

Will, on application, forward Catalogues of Chemical and Physical Apparatus, Pure Chemicals Special Reagent Bottles with Embossed Labels, Nitrometer, &c., &c.

GRIFFIN'S
CHEMICAL HANDICRAFT.
SECOND EDITION.
Price 4s. 7d. post free.

A CATALOGUE OF CHEMICAL APPARATUS:
ILLUSTRATED, CLASSIFIED, DESCRIPTIVE.
Demy 8vo., 480 pp., Illustrated with 1600 Woodcuts.
Most complete and cheapest List of Apparatus.

JOHN J. GRIFFIN and SONS, 22, Garrick Street, London, W.C.

THE JOURNAL OF SCIENCE
for MARCH (Price 1s. 6d.), includes—

The Evolution of the Spheres. By Charles Morris.
Offensive Manufactures: A Suggestion. By An Old Technologist.
On Living Organisms with reference to Polluted Waters. By J. W. Slater.
The Inconceivable as a Test of Truth. By F. H. Nash.
Experiments with the "Jumpers" of Maine. By George M. Beard, M.D.
Analyses of Books. Correspondence. Notes.

London: 3, Horse-Shoe Court, Ludgate Hill.

SOCIETY FOR THE ADVANCEMENT OF CHEMICAL INDUSTRY.

A Meeting, for the purpose of forming a Society for the Advancement of Chemical Industry, will be held on Monday, April 4th, 1881, in the rooms of the Chemical Society, Burlington House, Piccadilly, London, W., at 4 p.m.

Prof. ROSCOE, F.R.S., President of the Chemical Society, will occupy the chair.

All persons interested in the Chemical Industries are hereby invited to attend.

GEORGE E. DAVIS, Hon. Sec. *pro tem.*

THE LONDON HOSPITAL MEDICAL COLLEGE, MILE END, E.

The Hospital contains nearly 800 beds. The Summer Session will commence on May 2nd. Full Students now entering can compete for the Entrance Scholarships in October. All appointments are free to full Students. Special entries may be made for Medical and Surgica Practice, also for the Course of Practical Surgery.

MUNRO SCOTT, Warden.

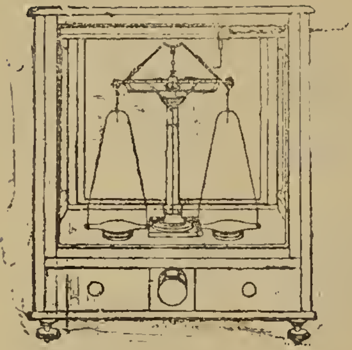
TO TAR DISTILLERS.

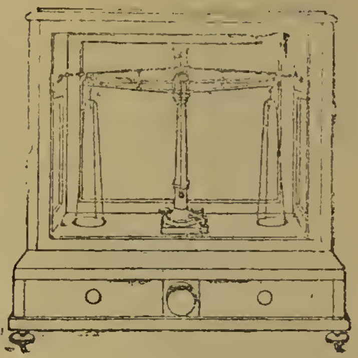
A Practical Man, of eight years' experience, is open for Engagement as Manager. Plant erected with all latest improvements. Thoroughly understands and can test all tar-products, carbolic, sulphate, rectifying benzol, &c.. First class references.—A. C., CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.

A First Class House in the Drug, &c., Trade, Established in Rhenish Prussia (Germany), wishes to undertake a Main Depot, or the exclusive sale of a suitable article, even if a speciality and not yet introduced.—Address, B. S., 85, care of Messrs. Haasenstein and Vogler, Cologne.

Wanted, to Purchase Volumes 1, 3, 5, 6, and 7, of the 'Journal of the Chemical Society"; also Vol. 3 of the "Proceedings of the Royal Society."—Address, K. P. G., CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.

Wanted, an Agent who calls on Chemical Manufacturers, to represent a New Invention, on Commission, —Address, B, and Co., Albion Works, Salford, Manchester.





Recently published, price 6s.

A TREATISE ON FUEL: Scientific and Practical. By ROBERT GALLOWAY, M.R.I.A., &c.
The best methods of estimating the heating power of fuels, and the technical examination and analysis of the different varieties of coal are fully described; and among the illustrations, drawn to scale, are Siemens's Regenerative Gas Furnace, Pyrometer, &c., with complete descriptions.

By the same Author,

In the Press, and will be published immediately,

EDUCATION, SCIENTIFIC and TECHNICAL; or,
HOW THE INDUCTIVE SCIENCES ARE TAUGHT; and HOW THEY OUGHT TO BE TAUGHT.

London: TRÜBNER and CO., Ludgate Hill.

SOLAR PHYSICS.

The following Courses of Lectures will be given by Members of the Committee on Solar Physics, appointed by the Lords of the Committee of Council on Education:—

An Introductory Lecture. By Professor Stokes, Sec. R.S. 6th April, 1881.

A Lecture on the Practical Importance of Studying the Influence of the Sun on Terrestrial Phenomena. By Lieut.-General Strachey, R.E., C.S.I., F.R.S. 8th April.

Two Lectures on the Connection between Solar and Terrestrial Phenomena. By Professor Balfour Stewart, F.R.S. 27th and 29th April.

Six Lectures on Spectroscopy in Relation to Solar Chemistry. By Mr. J. Norman Lockyer, F.R.S. 4th, 6th, 11th, 13th, 18th, and 20th May.

Three Lectures on the Photography of the Infra-red of the Spectrum in its Application to Solar Physics. By Captain Abney, R.E., F.R.S. 25th and 27th May and 1st June.

The Lectures will be delivered in the Lecture Theatre of the South Kensington Museum, at 4 p.m., on the days stated above.

Admission will be by Tickets, which may be obtained, as far as there is room, on application by letter to the Secretary, Science and Art Department, South Kensington, S.W.

AMMONIACAL LIQUOR.

THE DIRECTORS OF THE BRISTOL UNITED GAS LIGHT COMPANY invite TENDERS for the PURCHASE of the AMMONIACAL LIQUOR made at all or either of their THREE STATIONS, situate respectively at AVON STREET, CANONS' MARSH, and STAPLETON ROAD in the Borough of Bristol, for a TERM of FIVE or SEVEN YEARS, commencing on 1st JULY, 1882.

The Annual Quantity of Liquor produced at present at the three Stations is about 2½ millions of gallons.

Conditions of Contract and other particulars may be obtained of e SECRETARY, at the Office of the Company, Canon's Marsh, Bristol.

Tenders to be delivered on or before TUESDAY, 3rd day of May next, addressed to the Chairman of the Company, and marked 'Tender for Ammoniacal Liquor."

The Directors do not bind themselves to accept the highest or any Tender.

HENRY H. TOWNSEND, Secretary.

Gas Offices, Canons' Marsh, Bristol,
8th January, 1881.

WILLIAM AND WILLIAM T. FIELD,

MANUFACTURERS of the Celebrated STAFFORDSHIRE BLUE BRICKS, specially adapted for Chemical Plant, *i.e.*, Acid Towers, &c. Also all other kinds of Best Staffordshire Blue Bricks, Pavings, Plynths, Splays, Copings, &c. &c. Prices and samples on Application.

TESTIMONIAL

"We have used the Blue Staffordshire Brick or Sulphuric Acid Towers, &c., manufactured by Messrs. Field, for the last fifteen years during which time they have given great satisfaction. We recommend them to the Chemical Trade, believing there is nothing better in the market."—(Signed) WILLIAM HUNT and SONS, Lea Brook Alkali Works, near Wednesbury, Staffordshire, February, 1878.

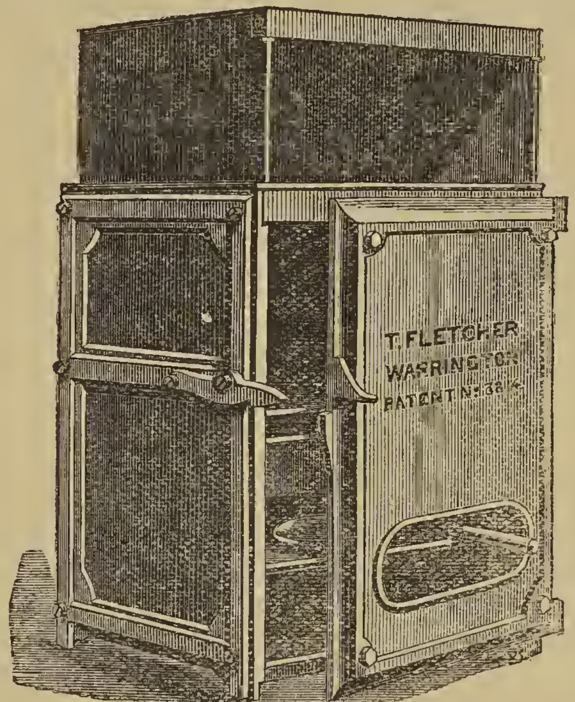
TOLL END BRICK-WORKS,
TIPTON, STAFFORDSHIRE.

BISULPHITE OF LIME.
BISULPHITE OF SODA.
SULPHITE OF SODA. TANNATE OF SODA

WILLIAM MARRIOTT
CHEMICAL WORKS, HUDDERSFIELD.

FLETCHER'S
PATENT VENTILATED
HOT-AIR OVEN.

At a cost of less than one halfpenny per hour for gas, this oven will grill, roast, toast, bake, warm dishes and plates; and with the assistance of Fletcher's Patent Solid Flame Boiling Burners will do everything possible with a first rate open fire (except drying clothes on washing days).



It is unapproached by any oven for pastry, and is fully hot in one minute after the gas is lighted.

Fish, joint, and pastry can be cooked all at once, in the most perfect manner, without the slightest taint from one to the other. The cooking is always good and always alike.

It will roast joint and fowls both at once, at least as well as an open fire.

Complete illustrated list of gas cooking and labour saving appliances free by post. List of Gas and Petroleum Laboratory Furnaces and Apparatus, price 2d.

THOS. FLETCHER,
4 & 6, MUSEUM STREET, WARRINGTON.

TETRACHLORIDE OF CARBON.
BISULPHIDE OF CARBON.
CHLORIDE OF SULPHUR.

JESSE FISHER & SON,
Phœnix Chemical Works Ironbridge.

MR. J. S. MERRY,
ASSAYER AND ANALYTICAL CHEMIST,
SWANSEA.

HYDRATE OF ALUMINA.

A. KEIFFENHEIM & CO.,
27, Side, Newcastle-on-Tyne.

BERNERS COLLEGE of CHEMISTRY.

Instruction and preparation in CHEMISTRY and the EXPERIMENTAL SCIENCES under the direction of Professor E. V. GARDNER, F.A.S., M.S.A.

The Class Rooms are open from 11 to 5 a.m. and from 7 to 10 p.m daily.

Especial facilities for persons preparing for Government and other examinations.

Private Pupils will find every convenience.

Analyses, Assays, and Practical Investigations connected with Patents, &c., conducted.

Prospectuses and full particulars on application to Prof Gardner at Berners College, 44, Berners-street W.

EGLINTON ALUM CLAY

(SIMILAR TO, BUT FREER FROM IRON THAN, BAUXITE).

THE EGLINTON CHEMICAL COMPANY, Limited, *who were the first to introduce this substance* to the notice of the Alum Trade, are now supplying it largely to Alum Manufacturers in this country and in America, Germany, and Russia, for the manufacture of Potash Alum and Sulphate of Alumina.

ANALYSIS OF DELIVERIES.

	Dried at 212° F.	
	First Quality.	Second Quality.
Alumina	52·37 per cent.	43·41 per cent.
Peroxide of Iron	1·29 ,,	1·81 ,,
Silica, &c.	19·24 ,,	34·35 ,,
Water of combination ...	27·13 ,,	20·52 ,,
	100·03	100·09

Being Shipowners, THE EGLINTON CHEMICAL CO., Lim., can guarantee regular delivery as may be required, and are prepared to quote a price f.o.b. at their private Harbours at Glenarm and Ballintoy, or delivered at Buyers' Works, in bulk or in bags, ground or unground.

WILLIAM J. A. DONALD, *Secretary and Manager.*

29, St. Vincent Place, Glasgow.

IRISH HILL BAUXITE (Alum Clay).

The IRISH HILL MINING CO. are now, and always have been, the LARGEST PRODUCERS OF THIS CLAY, of Superior Quality, and supply the Manufacturers of Alum, Sulphate of Alumina, and Alum-Cake, of the United Kingdom, America, and the Continent, almost exclusively.

Analysis by John Pattinson, Esq.

	Dried at 212° F.		
	Gertrude (extra qual.)	1st Quality.	2nd Quality.
Alumina	59·00	53·83	52·00
Peroxide of Iron	0·47	1·57	4·57
Silica	18·00	8·67	12·00
Titanic Acid		5·80	6·20
Lime, Magnesia, Potash, Soda, and Sulphuric Acid	0·23	0·83	1·14
Combined Water	22·30	29·27	24·00
	100·00	99·97	99·91

Our MINES, DRYING KILNS, and GRINDING MILLS are situated very close to the Shipping Ports of BELFAST and LARNE, and adjacent to Railways running alongside both Steamers and Sailing Vessels at both Ports, from either of which shipping is abundant and cheap, therefore we can guarantee Regular Delivery as Buyers require it, and are prepared to quote prices f.o.b. c.i.f., or delivered at any Port, in Bulk or Bags, Lump or Ground.

GEO. G. BLACKWELL, *Managing Director.*

Richmond Buildings, 26, Chapel St.,
Liverpool.

THE CHEMICAL NEWS
AND
JOURNAL OF PHYSICAL SCIENCE.

Edited by WILLIAM CROOKES, F.R.S.

Published every Friday. Price 4d. Annual Subscription, post free including Indices, £1

CHARGES FOR ADVERTISEMENTS.

	£	s.	d.
Five lines in column (about 10 words to line)	0	3	6
Each additional line	0	0	6
Whole column	1	15	0
Whole page	3	0	0

A reduction made for a series of insertions.

Cheques and Post-Office Orders, crossed "London and County Bank," payable to the order of William Crookes.

BOY COURT LUDGATE HILL LONDON, E.C

London: Printed and Published for the Proprietor by Edwin John Davey, at the Office, Boy Court, Ludgate Hill, E.C.
March 25, 1881.

PHARM
OF
GREAT BRITAIN

THE CHEMICAL NEWS

AND

JOURNAL OF PHYSICAL SCIENCE

Edited by Wm. Crookes, F.R.S. (WITH WHICH IS INCORPORATED THE "CHEMICAL GAZETTE") *Established Thirty-Eight Years.*

Vol. 43.—No. 1114. *Copyright reserved.* Friday, April 1, 1881. *Registered as a Newspaper.* PRICE, 4*d.* POST FREE, 4½*d.*

CONTENTS.

CAPPER PASS AND SON, BRISTOL,

ARE BUYERS OF

LEAD ASHES, SULPHATE OF LEAD,
LEAD SLAGS, ANTIMONIAL LEAD,
COPPER MATTE, TIN ASHES, &c.,
and DROSS or ORES containing
COPPER, LEAD, AND ANTIMONY.

Wanted, to Purchase Volumes 1, 3, 5, 6, and 7, of the 'Journal of the Chemical Society"; also Vol. 3 of the "Proceedings of the Royal Society."—Address, K. P. G., CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.

Wanted, an Agent who calls on Chemical Manufacturers, to represent a New Invention, on Commission.—Address, B. and Co., Albion Works, Salford, Manchester.

Wanted, in a Chemical Works, a Chemist, who has had experience in the Manufacture of Alkali including high strength caustic, and in the sulphur recovery process.—Address, N., CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.

Wanted, Laboratory Assistant of some practical experience, capable of investigating and applying his knowledge.—Address, stating age, experience, qualifications, and salary expected, to F. G. R., 243, Evernig Road, Upper Clapton, London.

FOR SALE, intact, the Fittings, Apparatus, and Reagents of a large and convenient Laboratory (rental low), in perfect working order, situated in the centre of a manufacturing district. Furnished with the most modern appliances, personally selected in England and Germany.—For further particulars apply by letter to No. 999, CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.

TAR.

The Directors of the Reading Gas Company are prepared to receive TENDERS for the purchase of their TAR for One, Two, or Three Years from the 1st of July next.

Specifications for the contracts can be seen at my office, or will be sent on application. Rail and water communication direct to the works.

Tenders to be sent not later than Monday, the 25th of April next, to— ROBT. BRADLEY, Secretary.

Office, 22, Market Place, Reading, March 29, 1881.

BRADY & MARTIN,
NEWCASTLE-ON-TYNE,

Will, on application, forward Catalogues of Chemical and Physical Apparatus, Pure Chemicals Special Reagent Bottles with Embossed Labels, Nitrometer, &c., &c.

GRIFFIN'S
CHEMICAL HANDICRAFT.
SECOND EDITION.
Price 4s. 7d. post free.

A CATALOGUE OF CHEMICAL APPARATUS:
ILLUSTRATED, CLASSIFIED, DESCRIPTIVE.
Demy 8vo., 480 pp., Illustrated with 1600 Woodcuts.
Most complete and cheapest List of Apparatus.

JOHN J. GRIFFIN and SONS, 22, Garrick Street, London, W.C.

THE JOURNAL OF SCIENCE
for MARCH (Price 1s. 6d.), includes—

The Evolution of the Spheres. By Charles Morris.
Offensive Manufactures: A Suggestion. By An Old Technologist.
On Living Organisms with reference to Polluted Waters. By J. W Slater.
The Inconceivable as a Test of Truth. By F. H. Nash.
Experiments with the "Jumpers" of Maine. By George M. Beard, M.D.
Analyses of Books. Correspondence. Notes.

London: 3, Horse-Shoe Court, Ludgate Hill.

SOCIETY FOR THE ADVANCEMENT OF CHEMICAL INDUSTRY.

A Meeting, for the purpose of forming a Society for the Advancement of Chemical Industry, will be held on Monday, April 4th, 1881, in the rooms of the Chemical Society, Burlington House, Piccadilly, London, W., at 4 p.m.

Prof. ROSCOE, F.R.S., President of the Chemical Society, will occupy the chair.

All persons interested in the Chemical Industries are hereby invited to attend.

GEORGE E. DAVIS, Hon. Sec. *pro tem.*

THE LONDON HOSPITAL MEDICAL COLLEGE, MILE END, E.

The Hospital contains nearly 800 beds. The Summer Session will commence on May 2nd. Full Students now entering can compete for the Entrance Scholarships in October. All appointments are free to full Students. Special entries may be made for Medical and Surgica Practice, also for the Course of Practical Surgery.

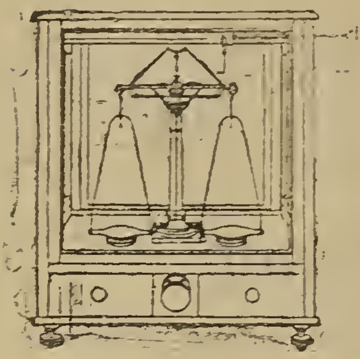
MUNRO SCOTT, Warden.

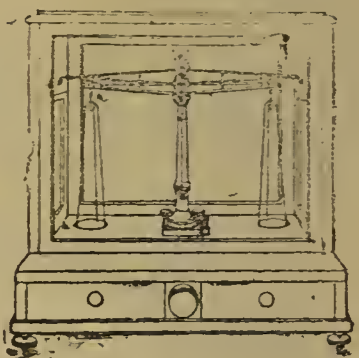
A Chemist, who has had six months' practical work as Junior Assistant in the Laboratory of a well-known Public Analyst, desires a Re-engagement.—J. W, 1, Dermody Rd., Lewisham, London, S.E.

Advertiser seeks Engagement as Assistant in Laboratory, or Chemist on Works, at home or abroad; well up in general analysis, also analysis under Food and Drugs Act; four years' experience.—Address, W. B., CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.

A Gentleman, with 8 years' experience, seeks an Appointment as Analytical Chemist in Works, or Assistant in a Laboratory. First class references.—Address, W., CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.

A Gentleman (conversant with Chemistry) is desirous of meeting with a Chemist, established in business, to whom his capital and additional aid would be of assistance in extending a connection.—Address, F. C. S., CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.





IRISH HILL BAUXITE (Alum Clay).

The **IRISH HILL MINING CO.** are now, and always have been, the LARGEST PRODUCERS OF THIS CLAY, of Superior Quality, and supply the Manufacturers of Alum, Sulphate of Alumina, and Alum-Cake, of the United Kingdom, America, and the Continent, almost exclusively.

Analysis by John Pattinson, Esq.

	Dried at 212° F. Gertrude (extra qual.)	1st Quality.	2nd Quality.
Alumina	59·00	53·83	52·00
Peroxide of Iron	0·47	1·57	4·57
Silica	18·00	8·67	12·00
Titanic Acid		5·80	6·20
Lime, Magnesia, Potash, Soda, and Sulphuric Acid	0·23	0·83	1·14
Combined Water	22·30	29·27	24·00
	100·00	99·97	99·91

Our MINES, DRYING KILNS, and GRINDING MILLS are situated very close to the Shipping Ports of BELFAST and LARNE, and adjacent to Railways running alongside both Steamers and Sailing Vessels at both Ports, from either of which shipping is abundant and cheap, therefore we can guarantee Regular Delivery as Buyers require it, and are prepared to quote prices f.o.b. c.i.f., or delivered at any Port, in Bulk or Bags, Lump or Ground.

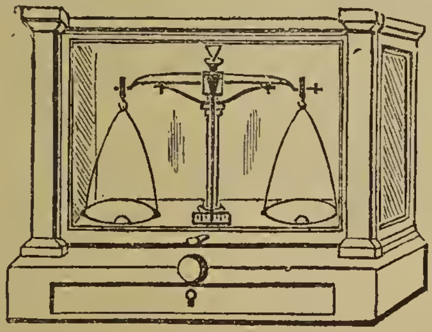
GEO. G. BLACKWELL, *Managing Director.*

Richmond Buildings, 26, Chapel St.,
Liverpool.

BECKER & SONS,

MANUFACTURERS OF
CHEMICAL AND GOLD ASSAY BALANCES
AND OTHER
SCALES AND WEIGHTS.

ROTTERDAM. NEW YORK.



BECKER'S STUDENT'S BALANCE, in polished mahogany glass case, sliding front, counterpoised, to carry 30 grammes in each pan and turn to ⅕ milligramme, nickel plated pans £2 10

Ditto, ditto, in mahogany glass case, polished black.. .. .. £2 13

Sole Agents for England, Ireland, and Wales:—

TOWNSON & MERCER.

Becker's Complete Lists forwarded by post on receipt of 1*d.* stamp or free on application.

SOUTH LONDON CENTRAL PUBLIC LABORATORY.

A Department has been opened for the Private Instruction of Gentlemen in Practical Chemistry as applied to any Special Industries or Commercial Products they may wish to study. For Fees, &c., apply to W. Baxter, Secretary, Central Public Laboratory, Kennington Cross, S.E.

BISULPHIDE OF CARBON
PROTOSULPHATE
RED OXIDE
OXYCHLORIDE

Sulphocyanide,
And every other Mercurial Preparation.
BISULPHITE OF LIME, TETRACHLORIDE OF CARBON.
Oxysulphuret of Antimony, Glacial Acetic Acid,

Liquor Ammoniæ,
Sulphide of Iron,
Pure Acids,
Chloride of Sulphur,
Acetone,
Chloroform,
Aldehyde,
Chlorate Baryta,
Arsenic Acids,
Fruit Essences for Confectionery & Liqueurs,
Perchloride of Iron,
Sulphite and Hyposulphite of Soda,
Phosphates of Soda and Ammonia,
Ethers,
Bromides,
Iodides,
Scale and Granular Preparations,
Sulphide of Sodium.

ALSO,
Pure Photographic Chemicals of every kind.
MANUFACTURED BY
WILLIAM BAILEY & SON,
HORSELEY FIELDS CHEMICAL WORKS,
WOLVERHAMPTON.

SILICATE OF SODA, Solid and in Solutions of Various Degrees of Concentration: the finest quality obtainable, and especially adapted for the use of Soap Makers and other Consumers.—JOSEPH CROSFIELD and SONS, Soap Makers, &c., Warrington.
London Agent—H. B. CLARKE, Great Tower Street, E.C.

DOULTON & WATTS

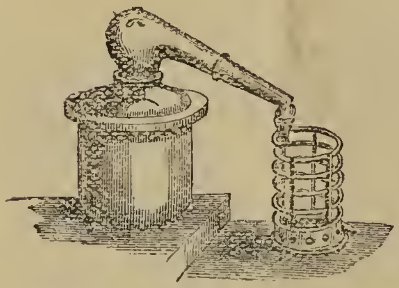
HIGH STREET, LAMBETH, LONDON, S.E.

MANUFACTURERS OF

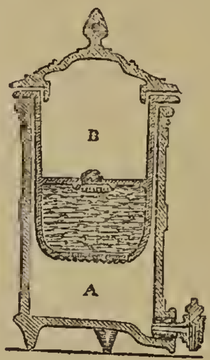
STILLS, RETORTS, CONDENSING WORMS, WOLFF'S BOTTLES,
ACID PUMPS, COCKS, PERCOLATORS, AIR-TIGHT JARS

And every description of Stoneware for Chemical Purposes,
warranted to resist the strongest acids.

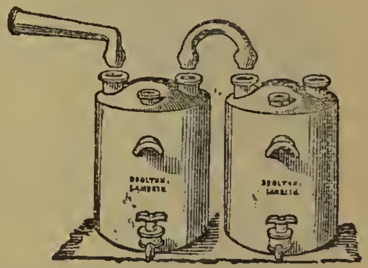
PLUMBAGO CRUCIBLES AND OTHER
FIRE-STANDING GOODS.



DOULTONS.
MANGANOUS



CARBON
FILTER.



(Dr. Bernays's Patent).

The Patent Manganous Carbon Filter combines important improvements in construction which have been effected by Messrs. Doulton & Co., in conjunction with a valuable discovery made by Dr Bernays, Professor of Chemistry at St. Thomas's Hospital; Public Analyst; Chemist to the Kent Water Works, &c., &c., &c.

NEW SHOW ROOMS, ALBERT EMBANKMENT, LAMBETH, S.E.
Depots:—Wood St., Birmingham; 100, Soho St., Liverpool; and 6, Rue de Paradis Poissonière, Paris.

Sulphate of Alumina

(CONCENTRATED ALUM),

Of the Richest and Purest Quality Produced in Great Britain.

MANUFACTURED UNDER CHADWICK'S AND KYNASTON'S PATENTS
BY THE

ST. HELENS CHEMICAL CO.,
ST. HELENS,
LANCASHIRE.

BISULPHIDE OF CARBON.

CHLORIDE OF SULPHUR.

GAS PURIFICATION & CHEMICAL CO., LIMITED,
161, 162, 163, Palmerston Buildings, London, E.C

THOMAS ADKINS & CO.,

SMETHWICK,
NEAR BIRMINGHAM.

Manufacturers of Specially Prepared Red Lead
for Flint-Glass Making.

FACTORIES.
Reddish and Bradford,
MANCHESTER.
BRONZE MEDAL, PARIS, 1867.

CHARLES LOWE & CO.,

(Established 1860.)

TOWN OFFICES:
43, Piccadilly,
MANCHESTER.
GOLD MEDAL, PARIS, 1878.

MANUFACTURERS OF

Pure Carbolic Acid, Cryst. at 42°·2 C. } Discovered by C. Lowe
,, ,, do. Hydrate of
Medicinal do. Cryst. at 35° C.
Commercial do. No. 1 ,, 35° C.
,, do. 2 ,, 29° C.
,, do. 3 ,, 12° C.
,, do. 4 liquid at 0° C.
Carbolic Acid Disinfecting Powder.

Carbolic Acid Glycerine Solutions.
Cresylic Acid.
Sulpho-Phenic Acid (Cryst.)
Sulpho-Phenates & Sulpho-Cresylates of Soda, Potash, Zinc, Iron, and Alumina.

Benzol (Cryst).
Anthracene.
Naphthaline.
Picric Acid (Cryst. and Paste).
Aurine (Rosolic Acid) Cake and Solution.

JOHN CLIFF,
STONEWARE MANUFACTURER,

Late JOHN CLIFF & Co.
Formerly STEPHEN GREEN.
of IMPERIAL POTTERIES,
LAMBETH.

OLD QUAY,
RUNCORN.

London: Printed and Published for the Proprietor by Edwin John Davey, at the Office, Boy Court, Ludgate Hill, E.C.
April 1, 1881.

THE

CHEMICAL NEWS

AND

JOURNAL OF PHYSICAL SCIENCE

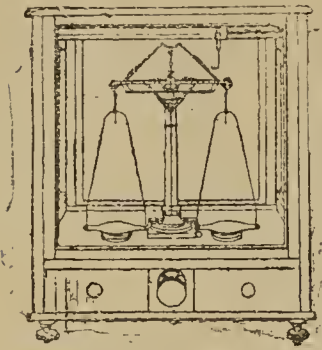
Edited by Wm. Crookes, F.R.S.]
(WITH WHICH IS INCORPORATED THE "CHEMICAL GAZETTE")
[*Established Thirty-Eight Years.*

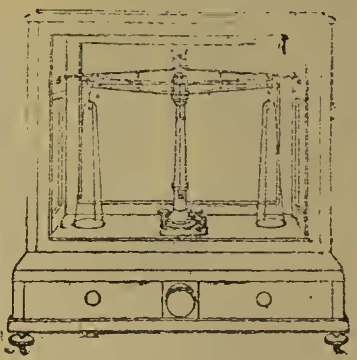
Vol. 43.—No. 1115.] *Copyright reserved.* Friday, April 8, 1881. *Registered as a Newspaper.* [PRICE, 4*d*. POST FREE, 4½*d*

CONTENTS.

NOTICE TO ADVERTISERS.

In consequence of GOOD FRIDAY occurring in the ensuing week, the CHEMICAL NEWS *will be published on Thursday next, April the 14th. Advertisements should therefore reach our Office not later than 10 a.m. on Wednesday, the 13th instant.*





London: Printed and Published for the Proprietor by Edwin John Davey, at the Office, Boy Court, Ludgate Hill, E.C.
April 8, 1881.

SOCIETY
OF
GREAT BRITAIN

THE

CHEMICAL NEWS

AND

JOURNAL OF PHYSICAL SCIENCE

Edited by
Wm. Crookes, F.R.S.]

(WITH WHICH IS INCORPORATED THE "CHEMICAL GAZETTE")

[*Established*
Thirty-Eight Years.

Vol. 43.—No. 1116.] *Copyright reserved.*

Thursday, April 14, 1881.

Registered as a Newspaper. [PRICE, 4d.
POST FREE, 4½d

CONTENTS.

CAPPER PASS AND SON, BRISTOL,

ARE BUYERS OF
LEAD ASHES, SULPHATE OF LEAD,
LEAD SLAGS, ANTIMONIAL LEAD,
COPPER MATTE, TIN ASHES, &c.,
and DROSS or ORES containing
COPPER, LEAD, AND ANTIMONY.

ROYAL INSTITUTION OF GREAT BRITAIN.
ALBEMARLE STREET, PICCADILLY, W.

LECTURE ARRANGEMENTS AFTER EASTER, 1881.

LECTURE HOUR, THREE O'CLOCK P.M.

PROFESSOR DEWAR, M.A., F.R.S.—Six Lectures on the Non-Metallic Elements; on Tuesdays, April 26 to May 31. One Guinea the Course.

PROFESSOR TYNDALL, D.C.L., F.R.S.—Six Lectures on Paramagnetism and Diamagnetism; on Thursdays, April 28 to June 2. One Guinea.

PROFESSOR H. MORLEY.—Three Lectures on Scotland's Part in English Literature; on Saturdays, April 30, May 7, 14. One Lecture on Thomas Carlyle; on Tuesday, June 7. Half-a-Guinea.

E. C. TURNER, Esq., Lector at the University of St. Petersburg.—Five Lectures on The Great Modern Writers of Russia; on Saturdays, May 21, 28, June 4, Thursday, June 9, and Saturday, June 11. Half-a-Guinea.

Subscription (to Non-Members) to all the Courses during the Season, Two Guineas.

TAR.

The Directors of the Reading Gas Company are prepared to receive TENDERS for the purchase of their TAR for One, Two, or Three Years from the 1st of July next.

Specifications for the contracts can be seen at my office, or will be sent on application. Rail and water communication direct to the works.

Tenders to be sent not later than Monday, the 25th of April next, to—
ROBT. BRADLEY, Secretary.
Office, 22, Market Place, Reading, March 29, 1881.

Ammonia Alum.—Wanted 5 or 10 Tons. If price and quality is right, would develop into a regular trade. Submit sample and price to GEO. G. BLACKWELL, 26, Chapel St., Liverpool.

BRADY & MARTIN,
NEWCASTLE-ON-TYNE,

Will, on application, forward Catalogues of Chemical and Physical Apparatus, Pure Chemicals Special Reagent Bottles with Embossed Labels, Nitrometer, &c., &c.

GRIFFIN'S
CHEMICAL HANDICRAFT.
SECOND EDITION.
Price 4s. 7d. post free.

A CATALOGUE OF CHEMICAL APPARATUS:
ILLUSTRATED, CLASSIFIED, DESCRIPTIVE.
Demy 8vo., 480 pp., Illustrated with 1600 Woodcuts.
Most complete and cheapest List of Apparatus.

JOHN J. GRIFFIN and SONS, 22, Garrick Street, London, W.C.

THE JOURNAL OF SCIENCE
for APRIL (Price 1s. 6d.), includes—

The Organisation of Matter. By Charles Morris.
The Future "Martyrdom of Science." By Frank Fernseed.
The Photophone. By J. Munro, C.E.
The Radiograph and its Uses.

Analyses of Books. Correspondence. Notes.

London: 3, Horse-Shoe Court, Ludgate Hill.

TEXT-BOOKS OF SCIENCE.
In small 8vo., with 372 Figures on Wood, price 6s., cloth,

SYSTEMATIC MINERALOGY.
By HILARY BAUERMANN, F.G.S., Associate of the Royal School of Mines. (Forming one of Messrs. Longmans and Co.'s Series of *Text-Books of Science, Mechanical and Physical*, edited by C. W MERRIFIELD, F.R.S.)

London: LONGMANS and CO.

THE LONDON HOSPITAL MEDICAL COLLEGE, MILE END, E.

The Hospital contains nearly 800 beds. The Summer Session will commence on May 2nd. Full Students now entering can compete for the Entrance Scholarships in October. All appointments are free to full Students. Special entries may be made for Medical and Surgical Practice, also for the Course of Practical Surgery.

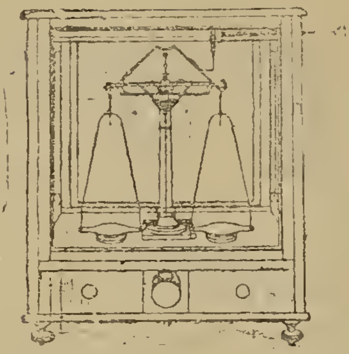
MUNRO SCOTT, Warden.

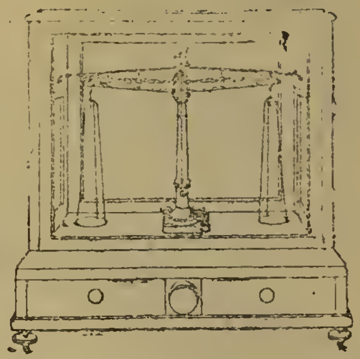
Wanted, a Competent and Trustworthy Man who thoroughly understands the Bisulphide Process of Recovering Oils.—Apply, by letter, to W. S, CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.

Wanted, a Practical Working Manager for Chemical Works, where the manufacture of vitriol (brown and rectified), muriatic acid, alum, &c., is carried on. Must understand the working of Glover and Gay Lussac towers.—Address, stating salary required, with testimonials and references, to John H. Mycock, Chemical Works, Rotherham.

Wanted, for a Cinchona Company in Ceylon, a first-class Analytical Chemist, to pursue experiments in respect to the growth, cultivation, and barking of Cinchona. Liberal salary, and employment guaranteed for two years at least. Passage out paid; furnished room on estates; and all laboratory expenses found.—Apply to Messrs. P. R. Buchanan and Co., 57, Gracechurch Street, London, E.C.

Wanted, to Purchase Volumes 1, 3, 5, 6, and 7, of the 'Journal of the Chemical Society"; also Vol. 3 of the "Proceedings of the Royal Society."—Address, K. P. G., CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.





MEETINGS FOR THE WEEK.

WEDNESDAY, 20th.—Meteorological, 7.
THURSDAY, 21st.—Chemical, 8. "On Fractional Distillation (Part II.)," F. D. Brown. "On the Estimation of Hydric Peroxide by means of Potassic Permanganate," W. E. Admey. "The Oxidation of Sulphurous Acid," H. B. Dixon.
FRIDAY, 22nd.—Quekett, 8.

NOTICE.

LIVERPOOL.

MR. A. NORMAN TATE, in reply to several inquiries from clients and others, and to avoid further misconception arising from similarity of his surname to that of one of the principals of another Chemical Establishment in this City, whose announcements of commencement of business have lately appeared, desires to say that his only Office and Laboratories are in HACKIN'S HEY.

The publishers of one Magazine, evidently misled by similarity of surname, having mentioned him (as "Mr. Norman Tate") as one of the Principals of the Liverpool College of Chemistry, he desires to say that he is in no way connected with that establishment, and he has no Partner.

ANALYTICAL LABORATORY AND SCHOOL OF TECHNICAL CHEMISTRY,
7, 8, 9, & 11, HACKIN'S HEY.

FOR SALE, SECONDHAND,
DEHNE'S FILTER-PRESSES.

One 24-chamber Press, absolute Washing Apparatus, plates 630 m.m. square, with iron sheets, stopcocks and brass couplings, juice controlling apparatus, and one spindle W. I. wheel for pressure up to 8 atmospheres.

One 24-chamber Press with frames for lifting out cakes of ⅜-inch, without washing apparatus, but with efflux cocks, iron sheets, top-side feed; pressure 8 atmospheres.—Address, "Filter," CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.

BERNERS COLLEGE of CHEMISTRY.

Instruction and preparation in CHEMISTRY and the EXPERIMENTAL SCIENCES under the direction of Professor E. V. GARDNER, F.A.S., M.S.A.

The Class Rooms are open from 11 to 5 a.m. and from 7 to 10 p.m daily.

Especial facilities for persons preparing for Government and other examinations.

Private Pupils will find every convenience.

Analyses, Assays, and Practical Investigations connected with Patents, &c., conducted.

Prospectuses and full particulars on application to Prof Gardner at Berners College, 44, Berners-street W.

WILLIAM AND WILLIAM T. FIELD,

MANUFACTURERS of the Celebrated STAFFORDSHIRE BLUE BRICKS, specially adapted for Chemical Plant, *i.e.*, Acid Towers, &c. Also all other kinds of Best Staffordshire Blue Bricks, Pavings, Plynths, Splays, Copings, &c, &c. Prices and samples on Application.

TESTIMONIAL

"We have used the Blue Staffordshire Brick or Sulphuric Acid Towers, &c., manufactured by Messrs. Field, for the last fifteen years during which time they have given great satisfaction. We recommend them to the Chemical Trade, believing there is nothing better in the market."—(Signed) WILLIAM HUNT and SONS, Lea Brook Alkali Works, near Wednesbury, Staffordshire, February, 1878.

TOLL END BRICK-WORKS,
TIPTON, STAFFORDSHIRE.

THE CHEMICAL NEWS
AND
JOURNAL OF PHYSICAL SCIENCE.

Edited by WILLIAM CROOKES, F.R.S.

Published every Friday. Price 4d. Annual Subscription, post free including Indices, £1

CHARGES FOR ADVERTISEMENTS.

	£	s.	d.
Five lines in column (about 10 words to line)	0	3	6
Each additional line	0	0	6
Whole column	1	15	0
Whole page	3	0	0

A reduction made for a series of insertions.

Cheques and Post-Office Orders, crossed "London and County Bank," payable to the order of William Crookes.

BOY COURT LUDGATE HILL LONDON, E.C

BISULPHIDE
OF CARBON
PROTOSULPHATE
RED OXIDE
OXYCHLORIDE
Sulphocyanide,
And every other Mercurial Preparation,

1862 LONDINI HONORIS CAUSA

BISULPHITE OF LIME, TETRACHLORIDE OF CARBON.
Oxysulphuret of Antimony, Glacial Acetic Acid,

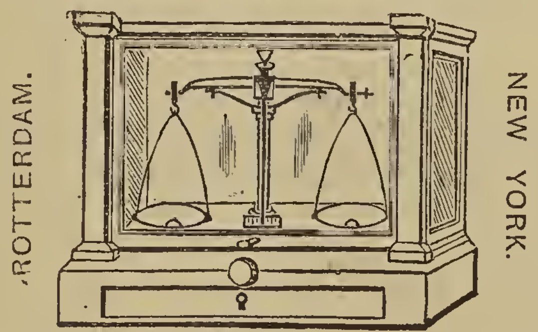
LIQUOR AMMONIÆ,
SULPHIDE OF IRON,
PURE ACIDS,
CHLORIDE OF SULPHUR,
ACETONE,
CHLOROFORM,
ALDEHYDE,
CHLORATE BARYTA,
ARSENIC ACIDS,
FRUIT ESSENCES FOR CONFECTIONERY & LIQUEURS,
PERCHLORIDE OF IRON,
SULPHITE AND HYPOSULPHITE OF SODA,
PHOSPHATES OF SODA AND AMMONIA,
ETHERS,
BROMIDES,
IODIDES,
SCALE AND GRANULAR PREPARATIONS,
SULPHIDE OF SODIUM.

ALSO,
Pure Photographic Chemicals of every kind,
MANUFACTURED BY
WILLIAM BAILEY & SON,
HORSELEY FIELDS CHEMICAL WORKS,
WOLVERHAMPTON.

SILICATE OF SODA, Solid and in Solutions of Various Degrees of Concentration: the finest quality obtainable, and especially adapted for the use of Soap Makers and other Consumers.—JOSEPH CROSFIELD and SONS, Soap Makers, &c., Warrington.

London Agent—H. B. CLARKE, Great Tower Street, E.C.

BECKER & SONS,
MANUFACTURERS OF
CHEMICAL AND GOLD ASSAY BALANCES
AND OTHER
SCALES AND WEIGHTS.



BECKER'S STUDENT'S BALANCE, in polished mahogany glass case, sliding front, counterpoised, to carry 30 grammes in each pan and turn to ½ milligramme, nickel plated pans £2 10
Ditto, ditto, in mahogany glass case, polished black.. .. .. £2 13

Sole Agents for England, Ireland, and Wales:—
TOWNSON & MERCER.

Becker's Complete Lists forwarded by post on receipt of 1d. stamp or free on application.

SOUTH LONDON CENTRAL PUBLIC LABORATORY.

A Department has been opened for the Private Instruction of Gentlemen in Practical Chemistry as applied to any Special Industries or Commercial Products they may wish to study. For Fees, &c., apply to W. BAXTER, Secretary, Central Public Laboratory, Kennington Cross, S.E.

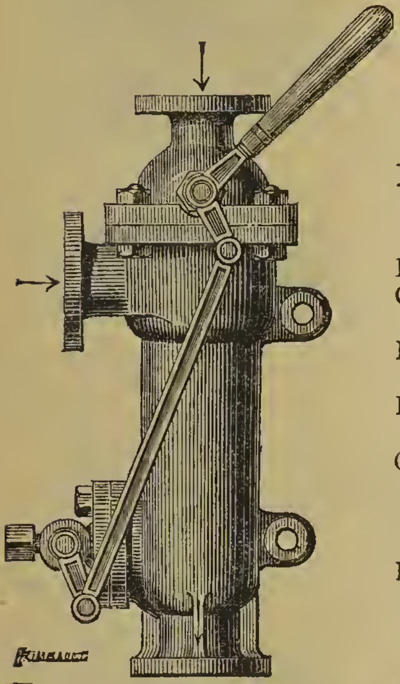
KÖRTING BROTHERS,

ENGINEERS,

17, LANCASTER AVENUE, FENNEL STREET,

MANCHESTER.

E. KÖRTING'S Patent Universal Injector



Works equally well non-lifting or lifting. Can be made to lift 24 ft. Works with high or low steam pressure. Works with hot or cold water. Forces the water into the boiler considerably above boiling point, thereby increasing the durability of the boiler.

IS STARTED BY SIMPLY TURNING ONE LEVER.

SUPPLIED TO:—

Belfast.	Corporation Gas Works	Leeds.	Corporation Gas Works.
Church.	Foxhillbank Printing Co.	Lincoln.	Messrs. Robey & Co.
Deptford.	Mr. A. J. Dickinson.	London.	May & Baker.
,,	R. Wheen & Sons.	,,	Merryweather & Sons.
Dublin.	A. Guinness, Sons, & Co.	,,	Victoria Graving Dock Co.
Glasgow.	Lloyd's Proving House.	Polmont.	Nobel's Explosive Co., Lim.
,,	P. & W. McClellan.	Sittingbourne.	Mr. E. Lloyd.
,,	A. Stephens & Sons.	Sunderland.	The Ford Works Co.
,,	Stevenson & Co.	Widnes.	Gaskell, Deacon, & Co.
Hebburn.	Tharsis Sulphur Co.	,,	Jas. Muspratt & Sons.

Price Lists and Testimonials on Application.

EGLINTON ALUM CLAY

(SIMILAR TO, BUT FREER FROM IRON THAN, BAUXITE).

THE EGLINTON CHEMICAL COMPANY, Limited, *who were the first to introduce this substance* to the notice of the Alum Trade, are now supplying it largely to Alum Manufacturers in this country and in America, Germany, and Russia, for the manufacture of Potash Alum and Sulphate of Alumina.

ANALYSIS OF DELIVERIES.

	Dried at 212° F.	
	First Quality.	Second Quality.
Alumina … … … …	52·37 per cent.	43·41 per cent.
Peroxide of Iron … …	1·29 ,,	1·81 ,,
Silica, &c. … … … …	19·24 ,,	34·35 ,,
Water of combination …	27·13 ,,	20·52 ,,
	100·03	100·09

Being Shipowners, THE EGLINTON CHEMICAL CO., Lim., can guarantee regular delivery as may be required, and are prepared to quote a price f.o.b. at their private Harbours at Glenarm and Ballintoy, or delivered at Buyers' Works, in bulk or in bags, ground or unground.

WILLIAM J. A. DONALD, *Secretary and Manager.*

29, St. Vincent Place, Glasgow.

London: Printed and Published for the Proprietor by EDWIN JOHN DAVEY, at the Office, Boy Court, Ludgate Hill, E.C. April 14, 1881.

THE
CHEMICAL NEWS
AND
JOURNAL OF PHYSICAL SCIENCE

Edited by Wm. Crookes, F.R.S.] (WITH WHICH IS INCORPORATED THE "CHEMICAL GAZETTE") [Established Thirty-Eight Years.

Vol. 43.—No. 1117.] Copyright reserved. Friday, April 22, 1881. Registered as a Newspaper. [Price, 4d. Post Free, 4½d

CONTENTS.

SOCIETY OF CHEMICAL INDUSTRY.

NOTICE IS HEREBY GIVEN, in accordance with a resolution unanimously passed at the Inaugural Meeting on April 4th, that all persons connected with Chemical Industries may, for the space of six months, become members of the above Society upon signing the necessary forms—which may be obtained from any of the Secretaries—provided such applicants be considered eligible by the Council, and that they pay a subscription of One Guinea for the *first* year, after which they shall conform to the bye-laws of the Society.

Members admitted during the first six months are exempted from the payment of an entrance fee.

The Society is intended to include all who are engaged in any Chemical Industry, or in any industry where Chemistry plays a part, and the Secretaries will be glad to give any information on the subject.

Application for membership may be made to any of the Secretaries, but addressed, care of Mr. THOMAS TYRER, Garden Wharf, Battersea, London, S.W.

The Council elected at the Inaugural Meeting is constituted as follows:—

President—Professor Roscoe, F.R.S.

Vice-Presidents—F. A. Abel, Esq, F.R.S.; Lowthian Bell, Esq., F.R.S.; F. H. Gossage, Esq; G. D. Longstaff, Esq., M.D.; E. K. Muspratt, Esq.; H. Lee Pattinson, Esq.: W. H. Perkin, Esq., F.R.S; Dr. C. W. Siemens, F.R.S; Dr. Angus Smith, F.R.S.; Walter Weldon, Esq., F.R.S.E.; Dr. A. W. Williamson, F.R.S.; Jas. Young, Esq., F.R.S.

Committee—W. de W. Abney, Esq., R.E., F.R.S.; Alexander Chance, Esq.; W. Crookes, Esq, F.R.S.; Dr. Charles Graham; Peter Griess, Esq., F.R.S.; D. B. Hewitt, Esq., M.D.: David Howard, Esq.; James Mactear, Esq.; John Spiller, Esq.; Dr. H. Sprengel, F.R.S.; H. Tate, jun., Esq; Philip Worley, Esq.

Treasurer—E. Rider Cook, Esq., East London Soap Works, Bow, E.

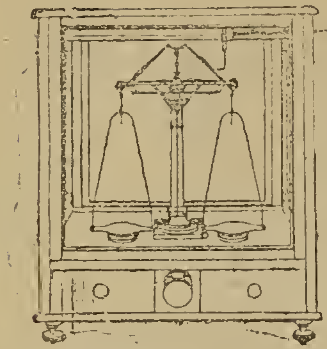
Secretaries—
Hon. General Sec.—George E. Davis, Heaton Chapel, Stockport.
Hon. Metropolitan Sec.—Thomas Tyrer, Garden Wharf, Battersea, London, S.W.
Hon. District Sec.—Eustace Carey, Widnes.
Hon. Foreign Sec.—Ludwig Mond, Winnington Hall, Northwich.

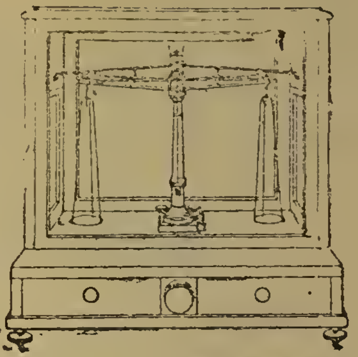
The first General Meeting will be held in London in June next, and due notice of the exact date will be given. At this meeting papers will be read, and matters relating to Chemical Industry discussed.

It is respectfully requested that all those gentlemen present at the Inaugural Meeting who did not append *their addresses* to the roll, and who desire to become members, will at once communicate with the Hon. Metropolitan Secretary.

Signed, H. E. ROSCOE, President.

April 18th, 1881.





CITY AND GUILDS OF LONDON INSTITUTE FOR THE ADVANCEMENT OF TECHNICAL EDUCATION.

SUMMER COURSES OF

LECTURES AND LABORATORY INSTRUCTION

At the temporary Classrooms of the Institute,

COWPER STREET, FINSBURY,

Commencing May 2nd, 1881.

CHEMICAL TECHNOLOGY—Prof. Armstrong, Ph.D., F.R.S.
EVENING COURSES:—
BREWING, Spirit Distilling, &c., Mondays.
PHOTOGRAPHY, Wednesdays.
DAY COURSES (Preliminary):—
LECTURES, Wednesdays and Fridays.
LABORATORY, Tuesdays and Fridays.

PHYSICAL TECHNOLOGY—Prof. Ayrton, A.M. Inst. C.E.
EVENING COURSES:—
ELECTRICAL INSTRUMENT MAKING, Tuesdays.
ELECTRIC LIGHTING, Fridays.
DAY COURSES (Preliminary):—
ELECTRICITY AND MAGNETISM, Mondays and Wednesdays.
LABORATORY PRACTICE, Mondays and Thursdays.

Evening Class for practice in Mathematical Calculations FREE to all Students attending any of the above Classes, Thursdays, 7.30 to 9.30.

FEES for Lectures and Laboratory Course together 5s. and 7s. 6d.

Detailed Prospectus on application to the Professors at Cowper Street Schools, or to Gresham College, E.C.

PHILIP MAGNUS, Director and Secretary.

WILLIAM AND WILLIAM T. FIELD,

MANUFACTURERS of the Celebrated STAFFORDSHIRE BLUE BRICKS, specially adapted for Chemical Plant, *i.e.*, Acid Towers, &c. Also all other kinds of Best Staffordshire Blue Bricks, Pavings, Plynths, Splays, Copings, &c. &c. Prices and samples on Application.

TESTIMONIAL

"We have used the Blue Staffordshire Brick or Sulphuric Acid Towers, &c., manufactured by Messrs. Field, for the last fifteen years during which time they have given great satisfaction. We recommend them to the Chemical Trade, believing there is nothing better in the market."—(Signed) WILLIAM HUNT and SONS, Lea Brook Alkali Works, near Wednesbury, Staffordshire, February, 1878.

TOLL END BRICK-WORKS,
TIPTON, STAFFORDSHIRE.

MOTTERSHEAD & CO.,

7, Exchange Street and 10, Half Moon Street,
MANCHESTER.

CHEMICAL & PHYSICAL APPARATUS,
BOTTLES, PURE CHEMICALS,
REAGENTS, STANDARD SOLUTIONS,
And Every Requirement for Works' or School Laboratories or Private Students.

Illustrated Price Lists on application.

THE CHEMICAL NEWS
AND
JOURNAL OF PHYSICAL SCIENCE.

Edited by WILLIAM CROOKES, F.R.S.

Published every Friday. Price 4d. Annual Subscription, post free including Indices, £1

CHARGES FOR ADVERTISEMENTS

	£	s.	d.
Five lines in column (about 10 words to line)	0	3	6
Each additional line	0	0	
Whole column	1	15	0
Whole page	3	0	0

A reduction made for a series of insertions.

Cheques and Post-Office Orders, crossed "London and County Bank," payable to the order of William Crookes.

BOY COURT LUDGATE HILL LONDON, E.C

A Chemist desires a Re-engagement. Has commercial experience, together with a knowledge of Mechanical Engineering, accustomed to conduct research, and would control whole or part of works or laboratory. Country preferred.—Address, E. 35, at C. H. May and Co.'s, 78, Gracechurch Street.

CHEMICAL PUPIL.

A Vacancy in the Laboratory of a London Chemist in extensive practice. Term, two years; Premium 100 guineas.—A. 1, CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.

ASSISTANT.

Wanted, a Junior Assistant in a Metallurgical Laboratory. When practically efficient a small salary will be given.—Apply by letter, E. Riley, 2, City Road, Finsbury Square, London.

Wanted, a Practical Working Manager for Chemical Works, where the manufacture of vitriol (brown and rectified), muriatic acid, alum, &c, is carried on. Must understand the working of Glover and Gay Lussac towers.—Address, stating salary required, with testimonials and references, to John H. Mycock, Chemical Works, Rotherham.

Wanted, to Purchase Volumes 1, 3, 5, 6, and 7, of the 'Journal of the Chemical Society"; also Vol. 3 of the "Proceedings of the Royal Society."—Address, K. P. G., CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.

TAR.

The Directors of the Reading Gas Company are prepared to receive TENDERS for the purchase of their TAR for One, Two, or Three Years from the 1st of July next.

Specifications for the contracts can be seen at my office, or will be sent on application. Rail and water communication direct to the works.

Tenders to be sent not later than Monday, the 25th of April next, to— ROBT. BRADLEY, Secretary.

Office, 22, Market Place, Reading, March 29, 1881.

Ammonia Alum.—Wanted 5 or 10 Tons. If price and quality is right, would develop into a regular trade. Submit sample and price to GEO. G. BLACKWELL, 26, Chapel St., Liverpool.

MR. J. S. MERRY,

ASSAYER AND ANALYTICAL CHEMIST.
SWANSEA.

BISULPHIDE OF CARBON
PROTOSULPHATE
RED OXIDE
OXYCHLORIDE
Sulphocyanide,
And every other Mercurial Preparation.

1862 LONDINI HONORIS CAUSA

BISULPHITE OF LIME, TETRACHLORIDE OF CARBON.

Oxysulphuret of Antimony, Glacial Acetic Acid,

LIQUOR AMMONIÆ,
SULPHIDE OF IRON,
PURE ACIDS,
CHLORIDE OF SULPHUR,
ACETONE,
CHLOROFORM,
ALDEHYDE,
CHLORATE BARYTA,
ARSENIC ACIDS,
FRUIT ESSENCES FOR CONFECTIONERY & LIQUEURS,
PERCHLORIDE OF IRON,
SULPHITE AND HYPOSULPHITE OF SODA,
PHOSPHATES OF SODA AND AMMONIA,
ETHERS,
BROMIDES,
IODIDES,
SCALE AND GRANULAR PREPARATIONS,
SULPHIDE OF SODIUM.

ALSO,
Pure Photographic Chemicals of every kind,
MANUFACTURED BY

WILLIAM BAILEY & SON,

HORSELEY FIELDS CHEMICAL WORKS,
WOLVERHAMPTON.

IRISH HILL BAUXITE (Alum Clay).

The **IRISH HILL MINING CO.** are now, and always have been, the LARGEST PRODUCERS OF THIS CLAY, of Superior Quality, and supply the Manufacturers of Alum, Sulphate of Alumina, and Alum-Cake, of the United Kingdom, America, and the Continent, almost exclusively.

Analysis by John Pattinson, Esq.

	Dried at 212° F.		
	Gertrude (extra qual.)	1st Quality.	2nd Quality.
Alumina	59·00	53·83	52·00
Peroxide of Iron	0·47	1·57	4·57
Silica	18·00	8·67	12·00
Titanic Acid		5·80	6·20
Lime, Magnesia, Potash, Soda, and Sulphuric Acid	0·23	0·83	1·14
Combined Water	22·30	29·27	24·00
	100·00	99·97	99·91

Our MINES, DRYING KILNS, and GRINDING MILLS are situated very close to the Shipping Ports of BELFAST and LARNE, and adjacent to Railways running alongside both Steamers and Sailing Vessels at both Ports, from either of which shipping is abundant and cheap, therefore we can guarantee Regular Delivery as Buyers require it, and are prepared to quote prices f.o.b. c.i.f., or delivered at any Port, in Bulk or Bags, Lump or Ground.

GEO. G. BLACKWELL, *Managing Director.*

Richmond Buildings, 26, Chapel St.,
Liverpool.

Established 1798.

ROBERT DAGLISH & CO.,

ENGINEERS, BOILER AND BRIDGE MAKERS, MILLWRIGHTS,

BRASS AND IRON FOUNDERS.

Manufacturers of every description of Condensing, or High-pressure Blowing, Pumping, Rolling, Winding, and Patent Steam-engines, of any required power, for Irrigating, Draining, Mining, Rolling Mills, or Water Works purposes, and Manufacturers of every description of Chemical, Colliery, Copper Ore, Gold Mining, Glass, and Rock-salt Machinery.

Black-ash Revolving Furnaces of the Most Approved Type.

Bessemer Steel-Rail Plant.

Compressing-Engines for Collieries, Iron Works, and Weldon's Patent Bleaching-Powder Process.

Caustic, Chlorate, Decomposing, Nitre Nitro-Glycerine, Iodine Potash, Sulphur, Acid, and Oxalic Pans.

Gas Producers Patent for Heating and other Purposes.

Pyrites Burners for Irish, Norwegian, and Spanish Ores of Improved Construction.

Patent Rousing Machinery for Brewers.

Retorts, Acid, Gas, Iodine, Nitric, Nitre Nitro-Glycerine and Vitriol Refining.

Steam Superheaters improved for Oil, Tar, and Resin Refining.

Steam Sulphur Melter.

Stills for Oil, Resin, and Tar.

Wheels, Bevel, Mitre, and Spur Moulded on the Shortest Notice by Patent Machinery.

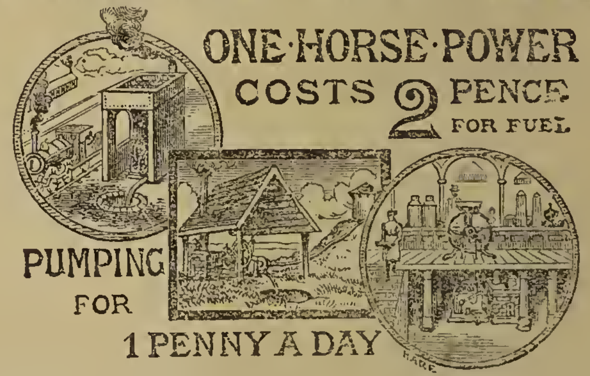
Makers of Mactear's Patent Carbonating Furnace, Jones and Walsh's Patent Sulphate of Soda Furnace, Parnell and Simpson's Patent Causticiser, and Kynaston's Patent Alum Plan

Lists sent on Application.

Photographs, Plans, and other information supplied on receipt of Order.

ST HELEN'S ENGINE, BOILER, AND BRIDGE WORKS AND FOUNDRY,
LANCASHIRE.

BAILEY'S PATENT HOT-AIR ENGINE.



Made from ½ to 5 horse-power. 56lbs. of coke will keep a 1-horse going 12 hours. 1000 galls. of water lifted 50 feet high for a penny.

NO BOILER. NO DANGER.

Awarded Prize Medal by the chief Societies.

SOLE MAKERS—
W. H. BAILEY & Co., Albion Works, Salford, Manchester

PURE HYDRATE OF ALUMINA.

A. KEIFFENHEIM & CO.,
27, Side, Newcastle-on-Tyne.

Water-Glass, or Soluble Silicates of Soda and Potash, in large or small quantities, and either solid or in solution, at ROBERT RUMNEY'S Ardwick Chemical Works Manchester.

TETRACHLORIDE OF CARBON.
BISULPHIDE OF CARBON.
CHLORIDE OF SULPHUR.

JESSE FISHER & SON,
Phœnix Chemical Works Ironbridge.

London: Printed and Published for the Proprietor by Edwin John Davey, at the Office, Boy Court, Ludgate Hill, E.C. April 22, 1881.

THE
CHEMICAL NEWS
AND
JOURNAL OF PHYSICAL SCIENCE

Edited by Wm. Crookes, F.R.S. (WITH WHICH IS INCORPORATED THE "CHEMICAL GAZETTE") Established Thirty-Eight Years.

Vol. 43.—No. 1118. Copyright reserved. Friday, April 29, 1881. Registered as a Newspaper. PRICE, 4d. POST FREE, 4½d

CONTENTS.

CAPPER PASS AND SON, BRISTOL,
ARE BUYERS OF
LEAD ASHES, SULPHATE OF LEAD,
LEAD SLAGS, ANTIMONIAL LEAD,
COPPER MATTE, TIN ASHES, &c.,
and DROSS or ORES containing
COPPER, LEAD, AND ANTIMONY.

ANALYTICAL & CONSULTING PRACTICE.
A Gentleman can be received in a first-class Laboratory to take the place of one of the Principals. No one need apply who does not possess a thoroughly good knowledge of Chemistry and Physics, and is of energetic and business habits.—Apply to Alpha, CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.

TO CHEMICAL MANUFACTURERS.
A Young Man of good experience in the Erection of Vitriol Chambers, Glover and Gay-Lussac Towers and Sulphate of Ammonia plants, seeks an Engagement as Plumber and Lead Burner, or would undertake the management in the manufacture of the above where plumbing is required.—For references, &c., apply A. H., 42, Turner's St., Commercial Road, London, E.

Wanted, Partner with knowledge of Chemistry in established business. Capital £1000 to £2000. Fair prospects. Communications confidential.—Apply, X. Y. Z., CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.

Wanted, for the Colonies, a thoroughly practical Man competent to undertake the erection of sulphuric acid works and the manufacture of acids, concentrated and brown, also artificial manures.—Address. G. E. W., care of Housekeeper, Mildmay Chambers, 82, Bishopsgate St., London, E.C.

THE LONDON HOSPITAL MEDICAL COLLEGE, MILE END, E.

The Hospital contains nearly 800 beds. The Summer Session will commence on May 2nd. Full Students now entering can compete for the Entrance Scholarships in October. All appointments are free to full Students. Special entries may be made for Medical and Surgical Practice, also for the Course of Practical Surgery.
MUNRO SCOTT, Warden.

BRADY & MARTIN,
NEWCASTLE-ON-TYNE,
Will, on application, forward Catalogues of Chemical and Physical Apparatus, Pure Chemicals' Special Reagent Bottles with Embossed Labels, Nitrometer, &c., &c.

GRIFFIN'S
CHEMICAL HANDICRAFT.
SECOND EDITION.
Price 4s. 7d. post free.

A CATALOGUE OF CHEMICAL APPARATUS:
ILLUSTRATED, CLASSIFIED, DESCRIPTIVE.
Demy 8vo., 480 pp., Illustrated with 1600 Woodcuts.
Most complete and cheapest List of Apparatus.

JOHN J. GRIFFIN and SONS, 22, Garrick Street, London, W.C.

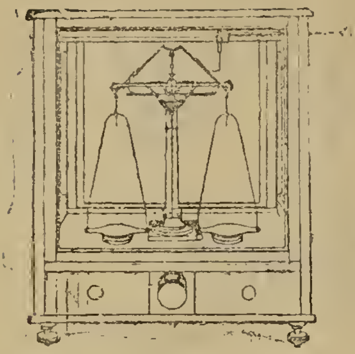
THE JOURNAL OF SCIENCE
for MAY (Price 1s. 6d.), include —
Scientific Arrogance. By Robert Ward.
The Evolution of the Solar System. By Charles Morris.
The Formative Power in Nature. By Sidney Billing.
Human Complexion and its Causes.
Chemical Shams. By J. Hepburn Davidson.
Explosives.
Analyses of Books. Correspondence. Notes.
London: 3, Horse-Shoe Court, Ludgate Hill.

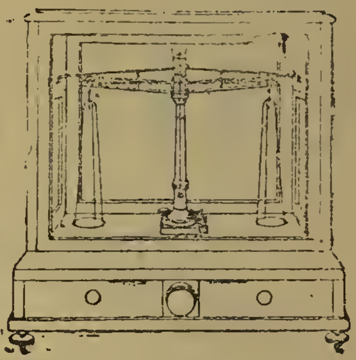
BREAD ANALYSIS: a Practical Treatise on the Examination of Flour and Bread. By J. A. WANKLYN and W. J. COOPER.
Published by the Authors, at 7, Westminster Chambers, S.W.
Price Five Shillings.

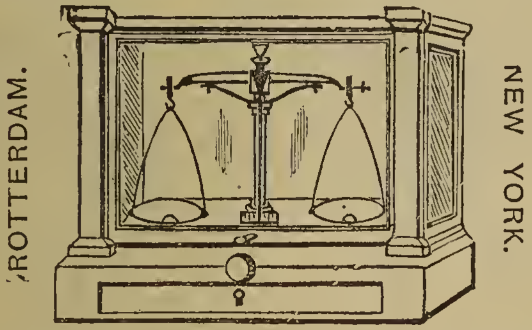
ATTFIELD'S CHEMISTRY,
GENERAL, MEDICAL, AND PHARMACEUTICAL.
A MANUAL OF CHEMISTRY FOR THE SUMMER SESSION OF THE MEDICAL SCHOOLS:
Including Analysis, Chemical Toxicology, Directions for Examining Morbid Urine, Urinary Sediments and Calculi, and the Synthetical Chemistry of the British Pharmacopœia.
Woodcuts of all Apparatus. Lithographs of Urinary Sediments.
BY JOHN ATTFIELD, F.R.S., &c.
Professor of Practical Chemistry to the Pharmaceutical Society of Great Britain; many years Demonstrator of Chemistry at St. Bartholomew's Hospital.
NINTH EDITION, 1881. PRICE, 15s.
"It contains a most admirable digest of what is specially needed by the medical student in all that relates to practical chemistry, and constitutes for him a sound and useful text-book on the subject."—*The Lancet.*
"For all the numerous class of students who are preparing for the medical or for the pharmaceutical profession, we know of no work in the language which can be compared with the one before us."—*Chemical News.*
JOHN VAN VOORST, 1, PATERNOSTER ROW.

LECTURE NOTES FOR CHEMICAL STUDENTS. By E. FRANKLAND, Ph.D., F.R.S., Professor of Chemistry in the Royal School of Mines, &c. Vol. I. (Inorganic), Sixth Thousand, 4s. Vol. II. (Organic), Third Edition, Revised by F. R. Japp, M.A., Ph.D., &c., 6s.
JOHN VAN VOORST, 1, Paternoster Row.

SAINT PAUL'S SCHOOLS.
About Eight Scholarships will be awarded next term.—For further information address Clerk to Governors, Mercer's Hall, E.C.






ROTTERDAM.
NEW YORK.

London: Printed and Published for the Proprietor by Edwin John Davey, at the Office, Boy Court, Ludgate Hill, E.C.
April 29, 1881.

SOCIETY
OF
GREAT BRIT

THE CHEMICAL NEWS AND JOURNAL OF PHYSICAL SCIENCE

(WITH WHICH IS INCORPORATED THE "CHEMICAL GAZETTE")

Edited by Wm. Crookes, F.R.S.

Established Thirty-Eight Years.

Vol. 43.—No. 1119.] *Copyright reserved.* Friday, May 6, 1881. *Registered as a Newspaper.* [PRICE, 4*d*. POST FREE, 4½*d*

CONTENTS.

CAPPER PASS AND SON, BRISTOL,
ARE BUYERS OF
LEAD ASHES, SULPHATE OF LEAD,
LEAD SLAGS, ANTIMONIAL LEAD,
COPPER MATTE, TIN ASHES, &c.,
and DROSS or ORES containing
COPPER, LEAD, AND ANTIMONY.

THE LONDON HOSPITAL MEDICAL COLLEGE, MILE END, E.

The Hospital contains nearly 800 beds. The Summer Session commenced on May 2nd. Full Students now entering can compete for the Entrance Scholarships in October. All appointments are free to full Students. Special entries may be made for Medical and Surgica Practice, also for the Course of Practical Surgery.

MUNRO SCOTT, Warden.

An Analyst, thoroughly qualified, with fifteen years' experience as Chemist and Manager of Works, will shortly be disengaged. Specialities—Soaps, candles, paraffin, palm oil, redeemed greases, oils, pearl-ash, tar-products, anthracen, benzol, gas-water, fuel, manures, water, minerals, &c.—Address, Methyl, CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.

TO IRON MERCHANTS AND MANUFACTURERS.

Wanted, several Secondhand Cast- and Wrought-Iron Tanks, from 400 to 1000 gallons; must be in good condition. Prices and particulars of dimensions to be addressed Z Y X, care of Messrs. G. J. Worssam and Son, Engineers, Wenlock Road, City Road, N.

CAUTION.

TO ALKALI MANUFACTURERS.

It having come to the knowledge of the undersigned that attempts are being made to introduce infringements of their patents for the Manufacture of Sulphates of Soda and Potash,

NOTICE IS HEREBY GIVEN, that any person or persons making use of such infringements will be prosecuted.

Middlesbro'-on-Tees,
May 2, 1881.

WM. JONES.
J. WALSH.

BRADY & MARTIN,
NEWCASTLE-ON-TYNE,
Will, on application, forward Catalogues of Chemical and Physical Apparatus, Pure Chemicals' Special Reagent Bottles with Embossed Labels, Nitrometer, &c., &c.

GRIFFIN'S
CHEMICAL HANDICRAFT.
SECOND EDITION.
Price 4s. 7d. post free.

A CATALOGUE OF CHEMICAL APPARATUS:
ILLUSTRATED, CLASSIFIED, DESCRIPTIVE.
Demy 8vo., 480 pp., Illustrated with 1600 Woodcuts.
Most complete and cheapest List of Apparatus.

JOHN J. GRIFFIN and SONS, 22, Garrick Street, London, W.C.

THE JOURNAL OF SCIENCE
for MAY (Price 1s. 6d.), include —

Scientific Arrogance. By Robert Ward.
The Evolution of the Solar System. By Charles Morris.
The Formative Power in Nature. By Sidney Billing.
Human Complexion and its Causes.
Chemical Shams. By J. Hepburn Davidson.
Explosives.

Analyses of Books. Correspondence. Notes.

London: 3, Horse-Shoe Court, Ludgate Hill.

LECTURE NOTES FOR CHEMICAL STUDENTS. By E. FRANKLAND, Ph.D., F.R.S., Professor of Chemistry in the Royal School of Mines, &c. Vol. I. (Inorganic), Sixth Thousand, 4s. Vol. II. (Organic), Third Edition, Revised by F. R. Japp, M.A., Ph.D., &c., 6s.

JOHN VAN VOORST, 1, Paternoster Row.

UNIVERSITY OF LONDON.

NOTICE IS HEREBY GIVEN, That the next Half-yearly Examination for MATRICULATION in this University will commence on MONDAY, the 20th of June, 1881. In addition to the Examination at the University, Provincial Examinations will be held at Owens College, Manchester; Queen's College, Liverpool; Queen's College, Birmingham; St. Cuthbert's College, Ushaw; Stonyhurst College; University College, Bristol; The Yorkshire College, Leeds; The School of Science and Art, Newcastle-on-Tyne; The Literary Institute, Edinburgh; St. Benedict's College, near Inverness; and (*for Ladies only*) at the Ladies' College, Cheltenham.

Every candidate is required to transmit his Certificate of Age to the Registrar (University of London, Burlington Gardens, London, W.), at least Fourteen Days before the commencement of the Examination.

ARTHUR MILMAN, M.A.,
Registrar.

April 30th, 1811.

TECHNICAL COLLEGE, GLASGOW.—
PRINTING AND DYEING BRANCH.

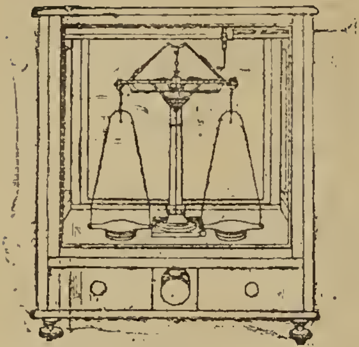
The Committee of the College in charge of this Department invite applications by gentlemen qualified to be Instructor, who must possess a thorough practical knowledge in Printing and Dyeing. Applicants must give references and state experience not later than 23rd May.

ROBERT FRAME, Secretary.

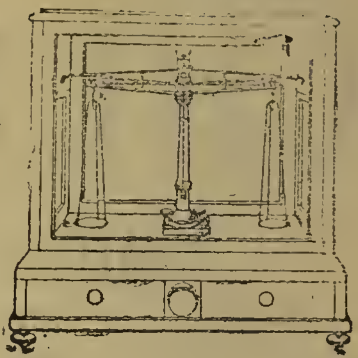
98, Bath Street, Glasgow,
30th April, 1881.

FOR SALE.

A Complete Set of CHEMICAL NEWS, 42 Volumes, bound in Red Cloth.—For price, &c., Address C.M.S., care of Office of the CHEMICAL NEWS, Boy Court, Ludgate Hill, London, E.C.



L. OERTLING, knowing that stands of his Balances are now being sold with beams which are not his manufacture, and *vice versa*, thereby making apparently two Oertling's Balances instead of only one, begs to notify that all Balances manufactured by him bear his name both on beam and stand.



AUG. BEL & CO.,

34, Maiden Lane, Covent Garden, London, W.C.

Importers and Manufacturers of Chemical and Scientific Apparatus, Pure Chemicals, &c.

Laboratories fitted up. Sets of Apparatus as required by the Universities, Colleges, and Schools, always ready and kept in stock. Professor Feser's Patent Lactoscope for Testing Milk, as recommended by Dr. Voelcker.

Description on application. A liberal discount allowed to the Trade.

UNIVERSAL

FILTER-PRESSES WITH FRAMES,

THE BEST FILTER-PRESS ON THE MARKET,

OF

1300 Filter presses in use

WEGELIN & HÜBNER, HALLE ON SAALE, GERMANY,

1300 Filter presses in use

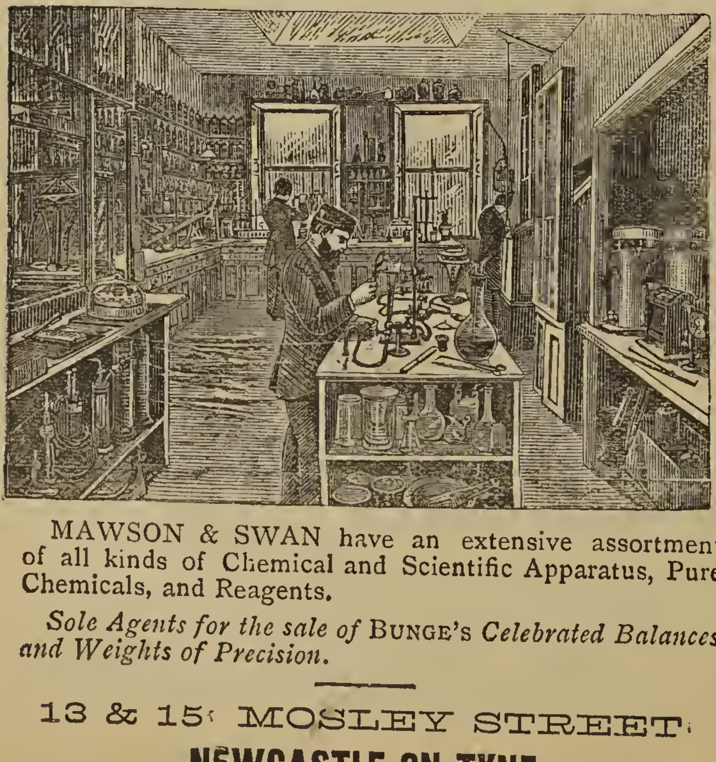
ENGINEERS AND IRONFOUNDERS.

Made in Wood, Iron, Bronze, or Lead, for the Filtration or Separation of Liquids from Solid Matters, with or without attachment, for the perfect washing of the latter.

MAWSON & SWAN,

LABORATORY OUTFITTERS,

IMPORTERS & MAKERS OF PHILOSOPHICAL INSTRUMENTS CHEMICAL, ELECTRICAL AND OTHER APPARATUS.



MAWSON & SWAN have an extensive assortment of all kinds of Chemical and Scientific Apparatus, Pure Chemicals, and Reagents.

Sole Agents for the sale of Bunge's *Celebrated Balances and Weights of Precision.*

13 & 15, MOSLEY STREET,
NEWCASTLE-ON-TYNE.

TOWNSON & MERCER,

89, Bishopsgate Street Within,
LONDON.

Wholesale and Export Dealers and Manufacturers of

CHEMICAL & SCIENTIFIC APPARATUS,

PURE CHEMICALS, &c.,

For Analysis and the general Laboratory Use of Manufacturers and Professors of Universities, Schools, Mines, &c.

Now ready,

TOWNSON & MERCER'S COMPLETE CATALOGUE of Chemical and Scientific Instruments, Pure Chemicals &c. Demy 8vo. Illustrated with upwards of 800 Woodcuts. Price 2s. 6d., post free.

Silicates of Soda and Potash in the state of Soluble Glass, or in CONCENTRATED SOLUTION of first quality, suited for the Manufacture of Soap and other purposes, supplied on best terms by W GOSSAGE and Sons, Soap Works, Widnes, Lancashire.

London Agents, COSTE and Co., 19 and 20, Water Lane, Tower Street, E.C., who hold stock ready for delivery

---

SULPHUROUS ACID.

SULPHITES AND BISULPHITES OF SODA AND LIME.

MAKERS:

A. BOAKE & CO.,

STRATFORD, LONDON, E.

London: Printed and Published for the Proprietor by Edwin John Davey, at the Office, Boy Court, Ludgate Hill E.C.
May 6, 1881.

THE
CHEMICAL NEWS
AND
JOURNAL OF PHYSICAL SCIENCE

Edited by Wm. Crookes, F.R.S.] (WITH WHICH IS INCORPORATED THE "CHEMICAL GAZETTE") [*Established Thirty-Eight Years.*

Vol. 43.—No. 1120.] *Copyright reserved.* Friday, May 13, 1881. *Registered as a Newspaper.* [PRICE, 4*d.* POST FREE, 4½*d.*

CONTENTS.

CAPPER PASS AND SON, BRISTOL,
ARE BUYERS OF
LEAD ASHES, SULPHATE OF LEAD,
LEAD SLAGS, ANTIMONIAL LEAD,
COPPER MATTE, TIN ASHES, &c.,
and DROSS or ORES containing
COPPER, LEAD, AND ANTIMONY.

CAUTION.
TO ALKALI MANUFACTURERS.

It having come to the knowledge of the undersigned that attempts are being made to introduce infringements of their patents for the Manufacture of Sulphates of Soda and Potash, NOTICE IS HEREBY GIVEN, that any person or persons making use of such infringements will be prosecuted.

Middlesbro'-on-Tees, May 2, 1881. WM. JONES. J. WALSH.

COPPER SMELTING.

APPLICATIONS FOR SHARES IN
THE MERSEY COPPER COMPANY, LIMITED,
Capital £15,000, in £10 Shares.
To be made to JOHN FENWICK ALLEN,
MERSEY COPPER WORKS, WIDNES.

☞ Articles of Association to be seen either at the registered office of the Company, Hutchinson St., Widnes, or at the office of Messrs. H. Forshaw and Hawkins, Solicitors, 2, Harrington Street, Liverpool. All particulars will be given at the office, Widnes, or at the Solicitors.

FOR SALE.

A Complete Set of CHEMICAL NEWS, 42 Volumes, bound in Red Cloth.—For price, &c., Address C.M.S., care of Office of the CHEMICAL NEWS, Boy Court, Ludgate Hill, London, E.C.

BRADY & MARTIN,
NEWCASTLE-ON-TYNE,
Will, on application, forward Catalogues of Chemical and Physical Apparatus, Pure Chemicals, Special Reagent Bottles with Embossed Labels, Nitrometer, &c., &c.

GRIFFIN'S
CHEMICAL HANDICRAFT.
SECOND EDITION.
Price 4s. 7d. post free.

A CATALOGUE OF CHEMICAL APPARATUS:
ILLUSTRATED, CLASSIFIED, DESCRIPTIVE.
Demy 8vo., 480 pp., Illustrated with 1600 Woodcuts.
Most complete and cheapest List of Apparatus.

JOHN J. GRIFFIN and SONS, 22, Garrick Street, London, W.C.

THE JOURNAL OF SCIENCE
for MAY (Price 1s. 6d.), include—
Scientific Arrogance. By Robert Ward.
The Evolution of the Solar System. By Charles Morris.
The Formative Power in Nature. By Sidney Billing.
Human Complexion and its Causes.
Chemical Shams. By J. Hepburn Davidson.
Explosives.
Analyses of Books. Correspondence. Notes.
London: 3, Horse-Shoe Court, Ludgate Hill.

TECHNICAL COLLEGE, GLASGOW.—
PRINTING AND DYEING BRANCH.

The Committee of the College in charge of this Department invite applications by gentlemen qualified to be Instructor, who must possess a thorough practical knowledge in Printing and Dyeing. Applicants must give references and state experience not later than 23rd May.

ROBERT FRAME, Secretary.
98, Bath Street, Glasgow,
30th April, 1881.

TO MAGNESIUM METAL DEALERS AND OTHERS.

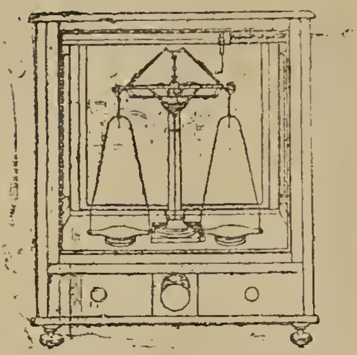
A Young Man, with a Practical Knowledge of Manufacturing Magnesium Metal, Sodium, Bismuth, Antimony, Tartar Emetic, Chlorate of Soda, Aniline Salts,—could make crucibles, &c.—seeks Situation as Manager or otherwise; could erect plant.—Address, Mr. T. Wilmot, 5, Devonshire Street, Hulme, Manchester.

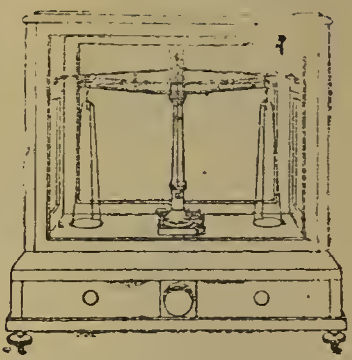
An Analytical and Technical Chemist is open to an Engagement; can plan and erect plant, and understands workmen.—Address, J. 206, Messrs. Deacon's Advertising Offices, Leadenhall Street, London.

Chemist (Young), all-round knowledge of Science and Engineering—five years education at home and in Germany—wishes Situation as Chemist or Assistant. Speaks French and German.—Address, 9090, CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.

Wanted, a Copper or Gun-metal Receiver, 12 or 18 gallons capacity, to withstand a vacuum. With or without hand-pump.—Answer by letter, with price, to E. Luck, 70, Stamford Street, S.E.

TO BE SOLD.—Chemical Apparatus, &c., the property of the late Dr. Hardwicke. Oertling's £20 Chemical Balance, nearly new, in perfect condition; three Platinum Basin; Franklin's Apparatus for Gas Analysis, complete with mercury, &c.; Complete Apparatus, in case, for Analysis of Air; also various other chemical appliances.—Apply, by letter, to the Executor, Richmond Villa, Fulham Place, Paddington.





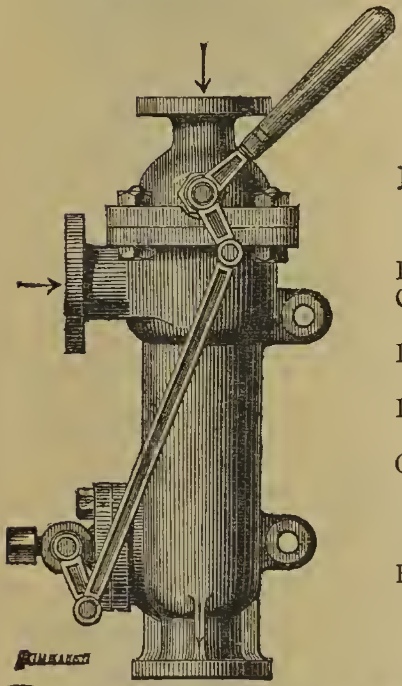
KÖRTING BROTHERS,

ENGINEERS,

17, LANCASTER AVENUE, FENNEL STREET,

MANCHESTER.

E. KÖRTING'S Patent Universal Injector



Works equally well non-lifting or lifting. Can be made to lift 24 ft. Works with high or low steam pressure. Works with hot or cold water. Forces the water into the boiler considerably above boiling point, thereby increasing the durability of the boiler.

IS STARTED BY SIMPLY TURNING ONE LEVER.

SUPPLIED TO:—

Belfast.	Corporation Gas Works	Leeds.	Corporation Gas Works.
Church.	Foxhillbank Printing Co.	Lincoln.	Messrs. Robey & Co.
Deptford.	Mr. A. J. Dickinson.	London.	May & Baker.
,,	R. Wheen & Sons.	,,	Merryweather & Sons.
Dublin.	A. Guinness, Sons, & Co.	,,	Victoria Graving Dock Co.
Glasgow.	Lloyd's Proving House.	Polmont.	Nobel's Explosive Co., Lim.
,,	P. & W. McClellan.	Sittingbourne.	Mr. E. Lloyd.
,,	A. Stephens & Sons.	Sunderland.	The Ford Works Co.
,,	Stevenson & Co.	Widnes.	Gaskell, Deacon, & C
Hebburn.	Tharsis Sulphur Co.	,,	Jas. Muspratt & Sons.

Price Lists and Testimonials on Application.

EGLINTON ALUM CLAY

(SIMILAR TO, BUT FREER FROM IRON THAN, BAUXITE).

THE EGLINTON CHEMICAL COMPANY, LIMITED, *who were the first to introduce this substance* to the notice of the Alum Trade, are now supplying it largely to ALUM MANUFACTURERS in this country and in America, Germany, and Russia, for the manufacture of Potash Alum and Sulphate of Alumina.

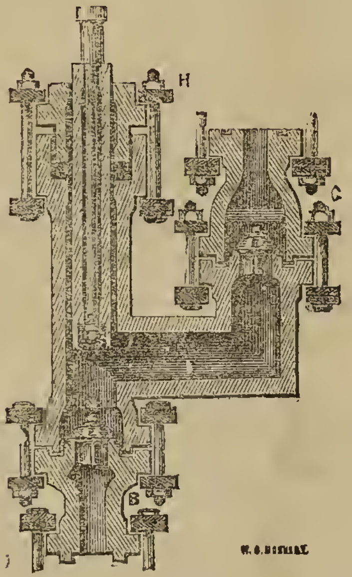
ANALYSIS OF DELIVERIES.

	Dried at 212° F.	
	First Quality.	Second Quality.
Alumina	52·37 per cent.	43·41 per cent.
Peroxide of Iron	1·29 ,,	1·81 ,,
Silica, &c.	19·24 ,,	34·35 ,,
Water of combination ...	27·13 ,,	20·52 ,,
	100·03	100·09

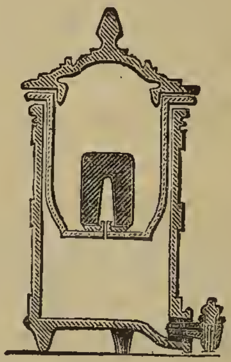
Being Shipowners, THE EGLINTON CHEMICAL CO., LIM., can guarantee regular delivery as may be required, and are prepared to quote a price f.o.b. at their private Harbours at Glenarm and Ballintoy, or delivered at Buyers' Works, in bulk or in bags, ground or unground.

WILLIAM J. A. DONALD, *Secretary and Manager.*

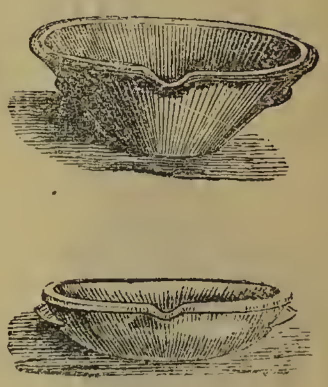
29, St. Vincent Place, Glasgow.



DOULTONS, MANGANOUS



CARBON FILTER.



London: Printed and Published for the Proprietor by Edwin John Davey, at the Office, Boy Court, Ludgate Hill E.C.
May 13, 1881.

SOCIETY OF GREAT BRITAIN

THE

CHEMICAL NEWS

AND

JOURNAL OF PHYSICAL SCIENCE

Edited by Wm. Crookes, F.R.S.] (WITH WHICH IS INCORPORATED THE "CHEMICAL GAZETTE") [*Established Thirty-Eight Years.*

Vol. 43.—No. 1121.] *Copyright reserved.* Friday, May 20, 1881. *Registered as a Newspaper.* [PRICE, 4*d*. POST FREE, 4½*d*

CONTENTS.

CAPPER PASS AND SON, BRISTOL,
ARE BUYERS OF
LEAD ASHES, SULPHATE OF LEAD,
LEAD SLAGS, ANTIMONIAL LEAD,
COPPER MATTE, TIN ASHES, &c.,
and DROSS or ORES containing
COPPER, LEAD, AND ANTIMONY.

A Chemist, First-class Organic and Inorganic (Royal School of Mines), passed Practical Examination Institute of Chemistry—worked on dyes—had nine months' experience on works and four years at chemistry—requires position as Chemist or Assistant on Works at home or abroad. Salary moderate.—"Ethyl," CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.

An Analytical and Technical Chemist is open to an Engagement; can plan and erect plant, and understands workmen.—Address, J. 206, Messrs. Deacon's Advertising Offices, Leadenhall Street, London.

Advertiser desires an Engagement in an Iron Works or General Laboratory either as an Assistant or to take sole charge. Three years' experience in general Analytical Chemistry. Salary moderate.—Address, "Analyst," 5, Dixon Terrace, Darlington.

Wanted, a Chemist thoroughly acquainted with the Manufacture of Saffranine and Roccelline.—Apply by letter to "Aniline," CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.

Wanted, to Purchase Volumes 1, 2, 3, 4, and 5 of the "Journal of Society of Telegraph Engineers."—Address, A. E. A., CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.

FOR SALE.
A Complete Set of CHEMICAL NEWS, 42 Volumes, bound in Red Cloth.—For price, &c., Address C.M.S., care of Office of the CHEMICAL NEWS, Boy Court, Ludgate Hill, London, E.C.

BRADY & MARTIN,
NEWCASTLE-ON-TYNE,
Will, on application, forward Catalogues of Chemical and Physical Apparatus, Pure Chemicals' Special Reagent Bottles with Embossed Labels, Nitrometer, &c., &c.

GRIFFIN'S
CHEMICAL HANDICRAFT.
SECOND EDITION.
Price 4s. 7d. post free.

A CATALOGUE OF CHEMICAL APPARATUS:
ILLUSTRATED, CLASSIFIED, DESCRIPTIVE.
Demy 8vo., 480 pp., Illustrated with 1600 Woodcuts.
Most complete and cheapest List of Apparatus.

JOHN J. GRIFFIN and SONS, 22, Garrick Street, London, W.C.

THE JOURNAL OF SCIENCE
for MAY (Price 1s. 6d.), incl

Scientific Arrogance. By Robert Ward.
The Evolution of the Solar System. By Charles Morris.
The Formative Power in Nature. By Sidney Billing.
Human Complexion and its Causes.
Chemical Shams. By J. Hepburn Davidson.
Explosives.
Analyses of Books. Correspondence. Notes.
London: 3, Horse-Shoe Court, Ludgate Hill.

SOCIETY OF CHEMICAL INDUSTRY.

NOTICE IS HEREBY GIVEN, that the First General Meeting of the above Society will be held in London on TUESDAY and WEDNESDAY, the 28th and 29th of June, at which papers of great interest will be read, and discussions take place thereon.

The full particulars and programme of this meeting will be advertised in these columns on the 18th of June.

Members and their friends will dine together on the evening of the 28th of June.

Gentlemen desirous of becoming Members of the Society are requested to communicate with Mr. THOS. TYRER, the Hon. Metropolitan Secretary, Garden Wharf, Battersea, London, S.W., or with the undersigned,

GEORGE E. DAVIS, Hon. General Secretary.
May 17, 1881. Heaton Chapel, Stockport.

BERNERS COLLEGE of CHEMISTRY

Instruction and preparation in CHEMISTRY and the EXPERIMENTAL SCIENCES under the direction of Professor E. V. GARDNER, F.A.S., M.S.A.

The Class Rooms are open from 11 to 5 a.m. and from 7 to 10 p.m daily.

Especial facilities or persons preparing for Government and other examinations.

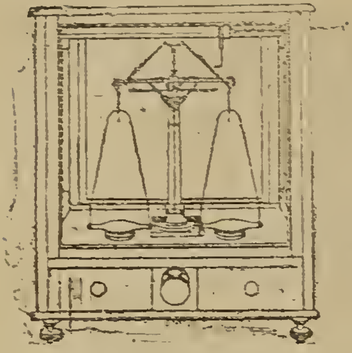
Private Pupils will find every convenience.

Analyses, Assays, and Practical Investigations connected with Patents, &c., conducted.

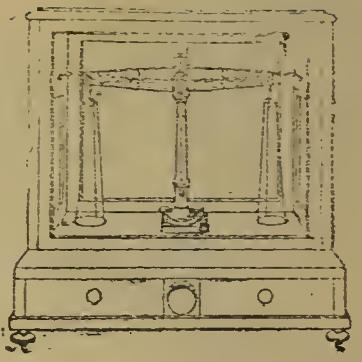
Prospectuses and full particulars on application to Prof Gar at Berners College, 44, Berners-street W.

MR. J. S. MERRY,
ASSAYER AND ANALYTICAL CHEMIST.
SWANSEA.

Water-Glass, or Soluble Silicates of Soda and Potash, in large or small quantities, and either solid or in solution, at ROBERT RUMNEY'S Ardwick Chemical Works Manchester.



L. OERTLING, knowing that stands of his Balances are now being sold with beams which are not his manufacture, and *vice versa*, thereby making apparently two OERTLING'S Balances instead of only one, begs to notify that all Balances manufactured by him bear his name both on beam and stand.



F. E. BECKER and Co., late
AUG. BEL & CO.,

34, Maiden Lane, Covent Garden, London, W.C.

***Importers** and Manufacturers of Chemical and Scientific Apparatus, Pure Chemicals, &c.*

NOW READY,

NEW ILLUSTRATED CATALOGUE OF CHEMICAL APPARATUS. Price, 1s., by post 1/2.

UNIVERSAL

FILTER-PRESSES WITH FRAMES,

THE BEST FILTER-PRESS ON THE MARKET,

OF

1300 Filter presses in use. **WEGELIN & HÜBNER, HALLE ON SAALE, GERMANY,** 1300 Filter presses in use.

ENGINEERS AND IRONFOUNDERS.

Made in Wood, Iron, Bronze, or Lead, for the Filtration or Separation of Liquids from Solid Matters, with or without attachment, for the perfect washing of the latter.

MAWSON & SWAN,

LABORATORY OUTFITTERS,

IMPORTERS & MAKERS OF PHILOSOPHICAL INSTRUMENTS CHEMICAL, ELECTRICAL AND OTHER APPARATUS.

MAWSON & SWAN have an extensive assortment of all kinds of Chemical and Scientific Apparatus, Pure Chemicals, and Reagents.

Sole Agents for the sale of BUNGE'S *Celebrated Balances and Weights of Precision.*

13 & 15 MOSLEY STREET,

NEWCASTLE-ON-TYNE.

TOWNSON & MERCER,

89, Bishopsgate Street Within,

LONDON.

Wholesale and Export Dealers and Manufacturers of

CHEMICAL & SCIENTIFIC APPARATUS,

PURE CHEMICALS, &c.,

For Analysis and the general Laboratory Use of Manufacturers and Professors of Universities, Schools, Mines, &c.

Now ready,

TOWNSON & MERCER'S COMPLETE CATALOGUE of Chemical and Scientific Instruments, Pure Chemicals &c. Demy 8vo. Illustrated with upwards of 800 Woodcuts. Price 2s. 6d., post free.

Silicates of Soda and Potash in the state of Soluble Glass, or in CONCENTRATED SOLUTION of first quality, suited for the Manufacture of Soap and other purposes, supplied on best terms by W GOSSAGE and Sons, Soap Works, Widnes, Lancashire.

London Agents, COSTE and Co., 19 and 20, Water Lane, Tower Street, E.C., who hold stock ready for delivery

---

SULPHUROUS ACID.

SULPHITES AND BISULPHITES OF

SODA AND LIME.

MAKERS:

A. BOAKE & CO.,

STRATFORD, LONDON, E.

ACTIEN-GESELLSCHAFT
FÜR
ANILIN-FABRIKATION,
BERLIN,

Manufacturers of Aniline Colours for Dyeing and Printing on Silk, Wool, Cotton, Leather, &c.

WORKS—Rummelsburg and Wiesenufer, near Berlin.
OFFICES—Treptower Brücke, S.O.
TELEGRAM—"Anilin," Berlin.

MANUFACTURERS OF

RUBINES,	Engl. Patent, No. 243 (1878)	ACID YELLOW	Germ. Patent, No. 4186
ACID-RUBINE	,, ,, 2828 (1879)	MALACHITE GREENS,	Engl. Patent, No. 828 (1878)
PONCEAUS	,, ,, 1715 (1878)	ACID MALACHITE GREEN	,, ,, 4406 (1878)
BORDEAUX	,, ,, 1715 (1878)	BENZYLE BLUES	
PHOSPHINES		WATER BLUES	
MANDARINES			

Eosines
Rosaniline Base
Safranines,
Coccines

Nigrosine
Coralline
Aurine
Martius Yellow
Berlin Brown
Regina Violet
Methyle Violets

Cotton Scarlets
Aurantia
Picric Acid
Methyl Orange

Hofmann Violet
Marine Blue
Paper Blue
Mode Brown
Nacarate
Bavarian Blues
Night Blue

Bismarck Brown
Aniline Gray
Methyle Greens
Spirit Blue

Humboldt Blue
Alkali (Nicholson) Blue
Guernsey Blue
Gentiana and Royal Blue(and Gray Pastes
China Blue
Indigo Blue

ANILINE OILS
ANILINE SALTS IN CAKES AND CRYSTALS

MIRBANE OIL
METHYLE ANILINE

Samples and Prices on Application. *Special Terms to Merchants and Shippers.*

All Genuine Packages are Protected by Trade-Mark.

*** Our Rubine (Magenta), and all Colours derived therefrom, are manufactured without employing Arsenic Acid.

Sulphate of Alumina

(CONCENTRATED ALUM),

Of the Richest and Purest Quality Produced in Great Britain.

MANUFACTURED UNDER CHADWICK'S AND KYNASTON'S PATENTS BY THE

ST. HELENS CHEMICAL CO.,
ST. HELENS,
LANCASHIRE.

WILLIAM AND WILLIAM T. FIELD,

MANUFACTURERS of the Celebrated STAFFORDSHIRE BLUE BRICKS, specially adapted for Chemical Plant, *i.e.*, Acid Towers, &c. Also all other kinds of Best Staffordshire Blue Bricks, Pavings, Plynths, Splays, Copings, &c. &c. Prices and samples on Application.

TESTIMONIAL

"We have used the Blue Staffordshire Brick or Sulphuric Acid Towers, &c., manufactured by Messrs. Field, for the last fifteen years during which time they have given great satisfaction. We recommend them to the Chemical Trade, believing there is nothing better in the market."—(Signed) WILLIAM HUNT and SONS, Lea Brook Alkali Works, near Wednesbury, Staffordshire, February, 1878.

TOLL END BRICK-WORKS,
TIPTON, STAFFORDSHIRE.

FACTORIES.
Reddish and Bradford,
MANCHESTER.
BRONZE MEDAL, PARIS, 1867.

CHARLES LOWE & CO.,
(Established 1860.)

TOWN OFFICES:
43, Piccadilly,
MANCHESTER.
GOLD MEDAL, PARIS, 1878.

MANUFACTURERS OF

Pure Carbolic	Acid, Cryst. at	42°·2 C.	} Discovered by C. Lowe
,, ,,	do. Hydrate of		
Medicinal	do. Cryst. at	35° C.	
Commercial	do. No. 1 ,,	35° C.	
,,	do. 2 ,,	29° C.	
,,	do. 3 ,,	12° C.	
,,	do. 4 liquid at	0° C.	

Carbolic Acid Disinfecting Powder.

Carbolic Acid Glycerine Solutions.
Cresylic Acid.
Sulpho-Phenic Acid (Cryst.)
Sulpho-Phenates & Sulpho-Cresylates of Soda, Potash, Zinc, Iron, and Alumina.

Benzol (Cryst.).
Anthracene.
Naphthaline.
Picric Acid (Cryst. and Paste).
Aurine (Rosolic Acid) Cake and Solution.

JOHN CLIFF,
STONEWARE MANUFACTURER,

Late JOHN CLIFF & Co.
Formerly STEPHEN GREEN.
OF IMPERIAL POTTERIES,
LAMBETH.

OLD QUAY,
RUNCORN.

London: Printed and Published for the Proprietor by Edwin John Davey, at the Office, Boy Court, Ludgate Hill E.C.
May 20, 1881.

THE

CHEMICAL NEWS

AND

JOURNAL OF PHYSICAL SCIENCE

Edited by Wm. Crookes, F.R.S.] (WITH WHICH IS INCORPORATED THE "CHEMICAL GAZETTE") [Established Thirty-Eight Years.

Vol. 43.—No. 1122.] Copyright reserved. Friday, May 27, 1881. Registered as a Newspaper. [PRICE, 4d. POST FREE, 4½d.

CONTENTS.

CAPPER PASS AND SON, BRISTOL,

ARE BUYERS OF

LEAD ASHES, SULPHATE OF LEAD,
LEAD SLAGS, ANTIMONIAL LEAD,
COPPER MATTE, TIN ASHES, &c.,
and DROSS or ORES containing
COPPER, LEAD, AND ANTIMONY.

Advertiser desires an Engagement in an Iron Works or General Laboratory either as an Assistant or to take sole charge. Three years' experience in general Analytical Chemistry. Salary moderate.—Address, "Analyst," 5, Dixon Terrace, Darlington.

Assistant wanted in a Chemical Laboratory in the City. Must be well versed in commercial work, especially in Manure and Water Analyses; salary commencing at £1 a week. —Address, C. F., 647, Deacon's Advertising Offices, 154, Leadenhall Street, E.C.

Wanted, Sulphocyanide of Barium and Sulphocyanide of Ammonium.—Address, No. 1000, CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.

Wanted, a Chemist thoroughly acquainted with the Manufacture of Saffranine and Roccelline.—Apply by letter to "Aniline," CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.

Wanted, to Purchase Volumes 1, 2, 3, 4, and 5 of the "Journal of Society of Telegraph Engineers."—Address, A. E. A., CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.

FOR SALE.

A Complete Set of CHEMICAL NEWS, 42 Volumes, bound in Red Cloth.—For price, &c., Address C.M.S., care of Office of the CHEMICAL NEWS, Boy Court, Ludgate Hill, London, E.C.

MYOCOM FLY GUM.

For the prevention of Flies and Wasps in Rooms, as advertised in the Daily Papers. Sold by all chemists, price 1s.
Wholesale of the Sole Registered Proprietors, THOS. CHRISTY and CO., 155, Fenchurch Street, London.

BRADY & MARTIN,
NEWCASTLE-ON-TYNE,

Will, on application, forward Catalogues of Chemical and Physical Apparatus, Pure Chemicals Special Reagent Bottles with Embossed Labels, Nitrometer, &c., &c.

GRIFFIN'S
CHEMICAL HANDICRAFT.
SECOND EDITION.
Price 4s. 7d. post free.

A CATALOGUE OF CHEMICAL APPARATUS:
ILLUSTRATED, CLASSIFIED, DESCRIPTIVE.
Demy 8vo., 480 pp., Illustrated with 1600 Woodcuts.
Most complete and cheapest List of Apparatus.

JOHN J. GRIFFIN and SONS, 22, Garrick Street, London, W.C.

THE JOURNAL OF SCIENCE

for MAY (Price 1s. 6d.), include —

Scientific Arrogance. By Robert Ward.
The Evolution of the Solar System. By Charles Morris.
The Formative Power in Nature. By Sidney Billing.
Human Complexion and its Causes.
Chemical Shams. By J. Hepburn Davidson.
Explosives.
Analyses of Books. Correspondence. Notes.
London: 3, Horse-Shoe Court, Ludgate Hill.

NEW WORK BY PROFESSOR GALLOWAY.

Just Published, price 10s. 6d.

EDUCATION, SCIENTIFIC and TECHNICAL; or,
HOW THE INDUCTIVE SCIENCES ARE TAUGHT; and HOW THEY OUGHT TO BE TAUGHT.

London: TRÜBNER and CO., Ludgate Hill.

UNIVERSITY COLLEGE, LIVERPOOL.

The Council of University College, Liverpool, and of the Liverpool Royal Infirmary School of Medicine, are prepared to appoint a PROFESSOR OF EXPERIMENTAL PHYSICS in connection with the above Institutions. The stipend of the Professor will be £400 per annum, together with a share of the Fees. The holder of this Professorship will be required to give instruction in Mathematics until a separate Chair of Mathematics shall have been endowed. He will also be expected to deliver a Course of Lectures to Evening Classes.

Applications and testimonials to be sent in not later than June 20th, 1881, to either of the undermentioned.

W. J. STEWART, 25, Lord Street, Liverpool, R. CATON, M.D., 18A. Abercromby Square, Liverpool.
May 18, 1881.

BERNERS COLLEGE of CHEMISTRY

Instruction and preparation in CHEMISTRY and the EXPERIMENTAL SCIENCES under the direction of Professor E. V. GARDNER, F.A.S., M.S.A.

The Class Rooms are open from 11 to 5 a.m. and from 7 to 10 p.m daily.

Especial facilities or persons preparing for Government and other examinations.

Private Pupils will find every convenience.

Analyses, Assays, and Practical Investigations connected with Patents, &c., conducted.

Prospectuses and full particulars on application to Prof Gardener at Berners College, 44, Berners-street W.

EGLINTON ALUM CLAY

(SIMILAR TO, BUT FREER FROM IRON THAN, BAUXITE).

THE EGLINTON CHEMICAL COMPANY, LIMITED, *who were the first to introduce this substance* to the notice of the Alum Trade, are now supplying it largely to ALUM MANUFACTURERS in this country and in America, Germany, and Russia, for the manufacture of Potash Alum and Sulphate of Alumina.

ANALYSIS OF DELIVERIES.

	Dried at 212° F.	
	First Quality.	Second Quality.
Alumina	52·37 per cent.	43·41 per cent.
Peroxide of Iron	1·29 ,,	1·81 ,,
Silica, &c.	19·24 ,,	34·35 ,,
Water of combination ...	27·13 ,,	20·52 ,,
	100·03	100·09

Being Shipowners, THE EGLINTON CHEMICAL CO., LIM., can guarantee regular delivery as may be required, and are prepared to quote a price f.o.b. at their private Harbours at Glenarm and Ballintoy, or delivered at Buyers' Works, in bulk or in bags, ground or unground.

WILLIAM J. A. DONALD, *Secretary and Manager.*

29, St. Vincent Place, Glasgow.

BECKER & SONS,

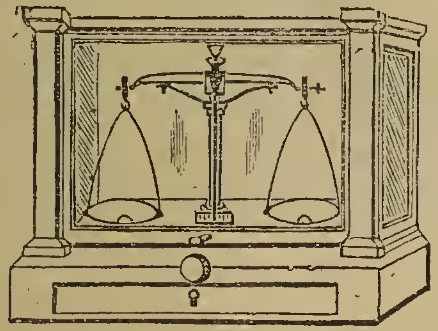
MANUFACTURERS OF

CHEMICAL AND GOLD ASSAY BALANCES

AND OTHER

SCALES AND WEIGHTS.

ROTTERDAM.



NEW YORK.

BECKER'S STUDENT'S BALANCE, in polished mahogany glass case, sliding front, counterpoised, to carry 30 grammes in each pan and turn to ½ milligramme, nickel plated pans £2 10

Ditto, ditto, in mahogany glass case, polished black.. .. .. £2 13

Sole Agents for England, Ireland, and Wales:—

TOWNSON & MERCER.

Becker's Complete Lists forwarded by post on receipt of 1*d.* stamp or free on application.

SOUTH LONDON CENTRAL PUBLIC LABORATORY.

A Department has been opened for the Private Instruction of Gentlemen in Practical Chemistry as applied to any Special Industries or Commercial Products they may wish to study. For Fees, &c., apply to W. Baxter, Secretary, Central Public Laboratory, Kennington Cross, S.E.

BISULPHIDE OF CARBON

PROTOSULPHATE

RED OXIDE

OXYCHLORIDE

Sulphocyanide,

And every other Mercurial Preparation.

BISULPHITE OF LIME, TETRACHLORIDE OF CARBON.

Oxysulphuret of Antimony, Glacial Acetic Acid,

Liquor Ammoniæ,

Sulphide of Iron,

Pure Acids,

Chloride of Sulphur,

Acetone,

Chloroform,

Aldehyde,

Chlorate Baryta,

Arsenic Acids,

Fruit Essences for Confectionery & Liqueurs,

Perchloride of Iron,

Sulphite and Hyposulphite of Soda,

Phosphates of Soda and Ammonia,

Ethers,

Bromides,

Iodides,

Scale and Granular Preparations,

Sulphide of Sodium.

ALSO,

Pure Photographic Chemicals of every kind.

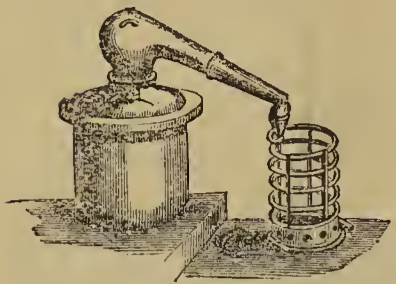
MANUFACTURED BY

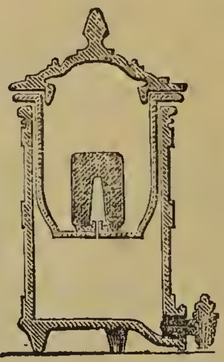
WILLIAM BAILEY & SON,

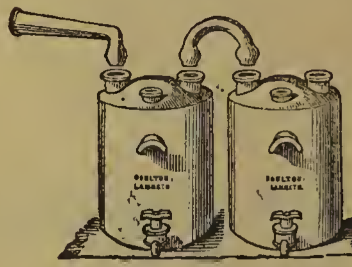
HORSELEY FIELDS CHEMICAL WORKS,
WOLVERHAMPTON.

SILICATE OF SODA, Solid and in Solutions of Various Degrees of Concentration: the finest quality obtainable, and especially adapted for the use of Soap Makers and other Consumers.—JOSEPH CROSFIELD and SONS, Soap Makers, &c., Warrington.

London Agent—H. B. CLARKE, Great Tower Street, E.C.







London: Printed and Published for the Proprietor by Edwin John Davey, at the Office, Boy Court, Ludgate Hill E.C.
May 27, 1881.

THE

CHEMICAL NEWS

AND

JOURNAL OF PHYSICAL SCIENCE

Edited by Wm. Crookes, F.R.S.] (WITH WHICH IS INCORPORATED THE "CHEMICAL GAZETTE") [*Established Thirty-Eight Years.*

Vol. 43.—No. 1123.] *Copyright reserved.* Friday, June 3, 1881. *Registered as a Newspaper.* [PRICE, 4*d.* POST FREE, 4½*d*

CONTENTS.

ARTICLES:— PAGE

CAPPER PASS AND SON, BRISTOL,

ARE BUYERS OF
LEAD ASHES, SULPHATE OF LEAD,
LEAD SLAGS, ANTIMONIAL LEAD,
COPPER MATTE, TIN ASHES, &c.,
and DROSS or ORES containing
COPPER, LEAD, AND ANTIMONY.

Advertiser desires an Engagement in an Iron Works or General Laboratory either as an Assistant or to take sole charge. Three years' experience in general Analytical Chemistry. Salary moderate.—Address, "Analyst," 5, Dixon Terrace, Darlington.

TO MANUFACTURERS.

Engagement Wanted. Many years Practical, Chemical, Mechanical, and General Experience in the Management of Works and Workmen. Charge of a small chemical factory preferred. Willing to be useful in any capacity.—Address, "Nitric," CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.

Wanted, by a Chemist (age 22), who has had some experience in general analytical work both mineral and organic, a Situation as Chemist or Assayer. Good references can be given. The advertiser having suffered from a spinal complaint when a child is below the average height.—H. Hucklebridge, 116, Ebury Street, London.

PARTNERSHIP.

Wanted, a Gentleman to join an established special Chemical Business near London: capital required £5000. A knowledge of chemistry advantageous, but not essential.—Reply to Alpha, CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.

TO POOR INVENTORS.—PATENTS PROCURED and Worked, or existing ones made profitable on mutual terms.—Send stamped envelope for particulars to E. S. GUNN, Patent Agent, 27, Chancery Lane.

FOR SALE.

A Complete Set of CHEMICAL NEWS, 42 Volumes, bound in Red Cloth.—For price, &c., Address C.M.S., care of Office of the CHEMICAL NEWS, Boy Court, Ludgate Hill, London, E.C.

BRADY & MARTIN,
NEWCASTLE-ON-TYNE,

Will, on application, forward Catalogues of Chemical and Physical Apparatus, Pure Chemicals Special Reagent Bottles with Embossed Labels, Nitrometer, &c., &c.

GRIFFIN'S
CHEMICAL HANDICRAFT.
SECOND EDITION.
Price 4s. 7d. post free.

A CATALOGUE OF CHEMICAL APPARATUS:
ILLUSTRATED, CLASSIFIED, DESCRIPTIVE.
Demy 8vo., 480 pp., Illustrated with 1600 Woodcuts.
Most complete and cheapest List of Apparatus.

JOHN J. GRIFFIN and SONS, 22, Garrick Street, London, W.C.

NEW WORK BY PROFESSOR GALLOWAY.

Just Published, price 10s. 6d.

EDUCATION, SCIENTIFIC and TECHNICAL; or, HOW THE INDUCTIVE SCIENCES ARE TAUGHT; and HOW THEY OUGHT TO BE TAUGHT.

London: TRÜBNER and CO., Ludgate Hill.

THE JOURNAL OF SCIENCE

for JUNE (Price 1s. 6d.), include—

Hylozoic Materialism. Communicated by Robert Lewins, M.D.
The Border-Land of Chemistry and Biology.
Scepticism in Geology. By Robert Ward.
The Philosophy of Pain. By Frank Fernseed.
The Weights and Measures Question Reconsidered. By an Old Technologist.

Analyses of Books. Correspondence. Notes.

London: 3, Horse-Shoe Court, Ludgate Hill.

SOCIETY OF CHEMICAL INDUSTRY.

NOTICE IS HEREBY GIVEN, that the First General Meeting of the above Society will be held in London on TUESDAY and WEDNESDAY, the 28th and 29th of June, at which papers of great interest will be read, and discussions take place thereon.

The full particulars and programme of this meeting will be advertised in these columns on the 18th of June.

Members and their friends will dine together on the evening of the 28th of June.

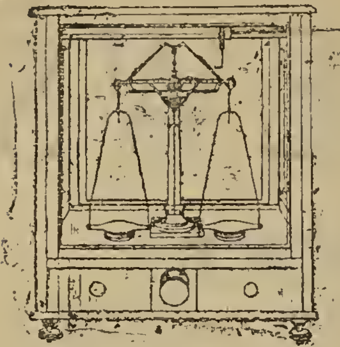
Gentlemen desirous of becoming Members of the Society are requested to communicate with Mr. THOS. TYRER, the Hon. Metropolitan Secretary, Garden Wharf, Battersea, London, S.W., or with the undersigned,

GEORGE E. DAVIS, Hon. General Secretary.
May 17, 1881. Heaton Chapel, Stockport.

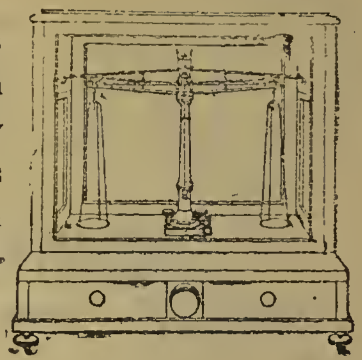
INSTITUTE OF CHEMISTRY.

NOTICE.—Candidates for the Associateship who intend entering for the Practical Examination in Chemistry in connection with the Institute—to be held in August—are requested to send in their Certificates in General and Theoretical Chemistry, Physics, and Elementary Mathematics, before the 20th June.—Particulars can be obtained on application to the Secretary, Mr. CHARLES E. GROVES, Somerset House Terrace, Strand, W.C.

FOR SALE.—Secondhand Bunge's Short Beam Balance and Set of Weights from 50 grms. to 1-1000 grms. Cost 15 gs., good condition, very little used. Also a Fletcher's Muffle Gas Furnace.—For prices, &c., address, "Newcastle," CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.



L. OERTLING, knowing that stands of his Balances are now being sold with beams which are not his manufacture, and *vice versa*, thereby making apparently two OERTLING'S Balances instead of only one, begs to notify that all Balances manufactured by him bear his name both on beam and stand.



F. E. BECKER and Co., late
AUG. BEL & CO.,

34, Maiden Lane, Covent Garden, London, W.C.

Importers and Manufacturers of Chemical and Scientific Apparatus, Pure Chemicals, &c.

NOW READY,

NEW ILLUSTRATED CATALOGUE OF CHEMICAL APPARATUS. Price, 1s., by post 1/2.

UNIVERSAL

FILTER-PRESSES WITH FRAMES,

THE BEST FILTER-PRESS ON THE MARKET,

1300 Filter presses in use.

OF

WEGELIN & HÜBNER, HALLE ON SAALE, GERMANY,

1300 Filter presses in use

ENGINEERS AND IRONFOUNDERS.

Made in Wood, Iron, Bronze, or Lead, for the Filtration or Separation of Liquids from Solid Matters, with or without attachment, for the perfect washing of the latter.

MAWSON & SWAN,

LABORATORY OUTFITTERS,

IMPORTERS & MAKERS OF PHILOSOPHICAL INSTRUMENTS, CHEMICAL, ELECTRICAL, AND OTHER APPARATUS.

MAWSON & SWAN have an extensive assortment of all kinds of Chemical and Scientific Apparatus, Pure Chemicals, and Reagents.

Sole Agents for the sale of BUNGE'S *Celebrated Balances and Weights of Precision.*

13 & 15 MOSLEY STREET.

NEWCASTLE-ON-TYNE.

TOWNSON & MERCER,

89, Bishopsgate Street Within,

LONDON.

Wholesale and Export Dealers and Manufacturers of

CHEMICAL & SCIENTIFIC APPARATUS,

PURE CHEMICALS, &c.,

For Analysis and the general Laboratory Use of Manufacturers and Professors of Universities, Schools, Mines, &c.

Now ready,

TOWNSON & MERCER'S COMPLETE CATALOGUE of Chemical and Scientific Instruments, Pure Chemicals &c. Demy 8vo. Illustrated with upwards of 800 Woodcuts. Price 2s. 6d., post free.

Silicates of Soda and Potash in the state of Soluble Glass, or in CONCENTRATED SOLUTION of first quality, suited for the Manufacture of Soap and other purposes, supplied on best terms by W GOSSAGE and Sons, Soap Works, Widnes, Lancashire.

London Agents, COSTE and Co., 19 and 20, Water Lane, Tower Street, E.C., who hold stock ready for delivery

---

SULPHUROUS ACID.

SULPHITES AND BISULPHITES OF

SODA AND LIME.

MAKERS:

A. BOAKE & CO.,

STRATFORD, LONDON, E.

EGLINTON ALUM CLAY

(SIMILAR TO, BUT CONTAINING LESS IRON THAN, BAUXITE).

THE EGLINTON CHEMICAL COMPANY, LIMITED, *who were the first to introduce this substance* to the notice of the Alum Trade, having shipped their first cargo of 100 tons in May, 1878, are now supplying it largely to ALUM MANUFACTURERS in this country and in America, Germany, and Russia, for the manufacture of Potash Alum and Sulphate of Alumina.

ANALYSIS OF DEVERIES.

	DRIED AT 212° F.		
	Extra Quality.	First Quality.	Second Quality.
Alumina	65·00 p. ct.	52·37 p. ct.	43·41 p. ct.
Peroxide of Iron	0·50 ,,	1·29 ,,	1·81 ,,
Silica, &c.	4·50 ,,	19·24 ,,	34·35 ,,
Water of combination ...	30·00 ,,	27·13 ,,	20·52 ,,
	100·00	100·03	100·09

Being Shipowners, THE EGLINTON CHEMICAL CO., LIM., can guarantee regular delivery as may be required, and are prepared to quote a price f.o.b. at their private Harbours at Glenarm and Ballintoy; f.o.b. at Larne or Belfast; or delivered at Buyers' Works, in bulk or in bags, ground or unground.

WILLIAM J. A. DONALD, *Secretary and Manager.*

29, ST. VINCENT PLACE, GLASGOW.

UNIVERSITY COLLEGE, LIVERPOOL.

The Council of University College, Liverpool, and of the Liverpool Royal Infirmary School of Medicine, are prepared to appoint a PROFESSOR OF EXPERIMENTAL PHYSICS in connection with the above Institutions. The stipend of the Professor will be £400 per annum, together with a share of the Fees. The holder of this Professorship will be required to give instruction in Mathematics until a separate Chair of Mathematics shall have been endowed, He will also be expected to deliver a Course of Lectures to Evening Classes.

Applications and testimonials to be sent in not later than June 20th, 1881, to either of the undermentioned.

W. J. STEWART, 25, Lord Street, Liverpool, R. CATON, M.D., 18A. Abercromby Square, Liverpool.

May 18, 1881.

BERNERS COLLEGE of CHEMISTRY.

Instruction and preparation in CHEMISTRY and the EXPERIMENTAL SCIENCES under the direction of Professor E. V. GARDNER, F.A.S., M.S.A.

The Class Rooms are open from 11 to 5 a.m. and from 7 to 10 p.m daily.

Especial facilities or persons preparing for Government and other examinations.

Private Pupils will find every convenience.

Analyses, Assays, and Practical Investigations connected with Patents, &c., conducted.

Prospectuses and full particulars on application to Prof Gardener at Berners College, 44, Berners-street W.

ROYAL POLYTECHNIC.—Lurline, the Rhine Maiden, by Mr. George Buckland.—Arctic Exploration, by Commander Cheyne, R.N.—Porcelain Manufacture, by Mr. J. D. Cogan.—The Photographer's Sunbeam, by Mr. T. C. Hepworth.—The Rising in the Transvaal, by Mr. W. R. May.—Etherdo, the Juggler.—The Microscope, Electricity, the Isle of Wight, &c., by Mr. J. L. King.—Fleuss's Diving Apparatus.—The Electric Railway. —Balmain's Luminous Paint Room.—Recitals by Mrs. Stirling and others, at 3 on Saturdays. Admission to the whole, 1s. Open from 12 till 5 and 7 till 10.

BISULPHIDE OF CARBON.

CHLORIDE OF SULPHUR.

GAS PURIFICATION & CHEMICAL CO., LIMITED,
161, 162, 163, PALMERSTON BUILDINGS, LONDON, E.C

MR. J. S. MERRY,

ASSAYER AND ANALYTICAL CHEMIST,
SWANSEA.

Water-Glass, or Soluble Silicates of Soda and Potash, in large or small quantities, and either solid or in solution, at ROBERT RUMNEY'S Ardwick Chemical Works Manchester.

THE CHEMICAL NEWS
AND
JOURNAL OF PHYSICAL SCIENCE.

Edited by WILLIAM CROOKES, F.R.S.

Published every Friday. Price 4d. Annual Subscription, post free including Indices, £1

CHARGES FOR ADVERTISEMENTS.

	£	s.	d.
Five lines in column (about 10 words to line)	0	3	6
Each additional line	0	0	6
Whole column	1	15	0
Whole page	3	0	0

A reduction made for a series of insertions.

Cheques and Post-Office Orders, crossed "London and County Bank," payable to the order of William Crookes.

BOY COURT LUDGATE HILL LONDON, E.C.

London: Printed and Published for the Proprietor by Edwin John Davey, at the Office, Boy Court, Ludgate Hill E.C.
June 3, 1881.

THE
CHEMICAL NEWS
AND
JOURNAL OF PHYSICAL SCIENCE

Edited by Wm. Crookes, F.R.S.] (WITH WHICH IS INCORPORATED THE "CHEMICAL GAZETTE") [*Established Thirty-Eight Years.*

Vol. 43.—No. 1124.] *Copyright reserved.* Friday, June 10, 1881. *Registered as a Newspaper.* [PRICE, 4*d.* POST FREE, 4½*d*

CONTENTS.

CAPPER PASS AND SON, BRISTOL,
ARE BUYERS OF
LEAD ASHES, SULPHATE OF LEAD,
LEAD SLAGS, ANTIMONIAL LEAD,
COPPER MATTE, TIN ASHES, &c.,
and DROSS or ORES containing
COPPER, LEAD, AND ANTIMONY.

A Chemist (24), Englishman, who has studied in England and on the Continent, and has just completed a three years' engagement in a large Print Works, desires a Re-engagement, either at home or abroad. Is well up in analysis. Speaks French and German, and has good knowledge of Italian.—Address J.T., CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.

Wanted, for a Young Man who has had considerable experience in metallurgical processes and chemical analysis, an appointment in Works where his experience and energy could be utilised with a view to Partnership. Large available capital. —Apply, A. B. C., CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.

Assistant Chemist required. Well up in Organic Chemistry; capable of making daily analyses in a small manufactory.—Apply by letter to E. S., 23, Norfolk Street, Strand.

Wanted a thoroughly reliable, energetic, and competent man to act as Foreman at a Branch Chemical Works near Liverpool. Must be able to superintend the erection of buildings and setting down of plant, machinery, &c., and having a good engineering and chemical knowledge.—No one need apply unless with the highest references as to character and ability.—Address, stating full particulars of qualifications and salary required, to "Foreman," care of Lee and Nightingale, Advertising Agents, Liverpool.

FOR SALE.
A Complete Set of CHEMICAL NEWS, 42 Volumes, bound in Red Cloth.—For price, &c., Address C.M.S., care of Office of the CHEMICAL NEWS, Boy Court, Ludgate Hill, London, E.C.

BRADY & MARTIN,
NEWCASTLE-ON-TYNE,
Will, on application, forward Catalogues of Chemical and Physical Apparatus, Pure Chemicals Special Reagent Bottles with Embossed Labels, Nitrometer, &c., &c.

GRIFFIN'S
CHEMICAL HANDICRAFT.
SECOND EDITION.
Price 4s. 7d. post free.

A CATALOGUE OF CHEMICAL APPARATUS:
ILLUSTRATED, CLASSIFIED, DESCRIPTIVE.
Demy 8vo., 480 pp., Illustrated with 1600 Woodcuts.
Most complete and cheapest List of Apparatus.

JOHN J. GRIFFIN and SONS, 22, Garrick Street, London, W.C.

NEW WORK BY PROFESSOR GALLOWAY.

Just Published, price 10s. 6d.
EDUCATION, SCIENTIFIC and TECHNICAL; or,
HOW THE INDUCTIVE SCIENCES ARE TAUGHT; and
HOW THEY OUGHT TO BE TAUGHT.
London: TRÜBNER and CO., Ludgate Hill.

THE JOURNAL OF SCIENCE
for JUNE (Price 1s. 6d.), include—

Hylozoic Materialism. Communicated by Robert Lewins, M.D.
The Border-Land of Chemistry and Biology.
Scepticism in Geology. By Robert Ward.
The Philosophy of Pain. By Frank Fernseed.
The Weights and Measures Question Reconsidered. By an Old Technologist.

Analyses of Books. Correspondence. Notes.
London: 3, Horse-Shoe Court, Ludgate Hill.

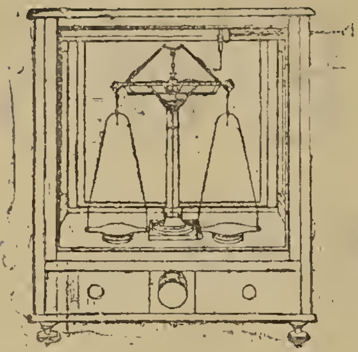
INSTITUTE OF CHEMISTRY.

NOTICE.—Candidates for the Associateship who intend entering for the Practical Examination in Chemistry in connection with the Institute—to be held in August—are requested to send in their Certificates in General and Theoretical Chemistry, Physics, and Elementary Mathematics, before the 20th June.—Particulars can be obtained on application to the Secretary, Mr. CHARLES E. GROVES, Somerset House Terrace, Strand, W.C.

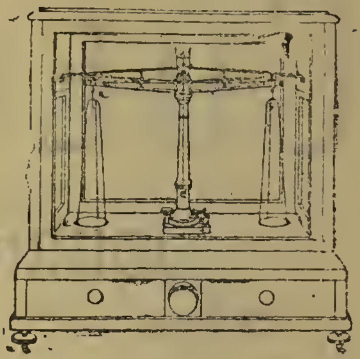
THE VICTORIA UNIVERSITY,
MANCHESTER.
The Statutes and Regulations regarding Degrees, Examinations, and Courses of Study are now published. Students and others desirous of information may obtain copies on application to the Registrar.
R. ADAMSON, Registrar.

TO MAGNESIUM METAL DEALERS AND OTHERS.
A Young Man, with a Practical Knowledge of Manufacturing Magnesium Metal, Sodium, Bismuth, Antimony, Tartar Emetic, Chlorate of Soda, Aniline Salts,—could make crucibles, &c.—seeks Situation as Manager or otherwise; could erect plant.—Address, Mr. T. Wilmot, 5, Devonshire Street, Hulme, Manchester.

TO POOR INVENTORS.—PATENTS PROCURED and Worked, or existing ones made profitable on mutual terms.—Send stamped envelope for particulars to E. S. GUNN, Patent Agent, 27, Chancery Lane.



L. OERTLING,
TURNMILL STREET
(OPPOSITE FARRINGDON STREET STATION.)
MANUFACTURER OF
CHEMICAL, ASSAY, & BULLION BALANCES
Maker to the Bank of England, Assay Office of the Royal Mint, &c., &c.
By Appointment.
COUNCIL MEDAL, 1851. FIRST CLASS MEDAL, 1854 and 1862.



BISULPHIDE OF CARBON.
CHLORIDE OF SULPHUR.

GAS PURIFICATION & CHEMICAL CO., LIMITED,
161, 162, 163, Palmerston Buildings, London, E.C

TETRACHLORIDE OF CARBON.
BISULPHIDE OF CARBON.
CHLORIDE OF SULPHUR.

JESSE FISHER & SON,
Phœnix Chemical Works Ironbridge.

UNIVERSAL
FILTER-PRESSES WITH FRAMES,
THE BEST FILTER-PRESS ON THE MARKET,
OF
1300 Filter presses in use. WEGELIN & HÜBNER, HALLE ON SAALE, GERMANY, 1300 Filter presses in use
ENGINEERS AND IRONFOUNDERS.
Made in Wood, Iron, Bronze, or Lead, for the Filtration or Separation of Liquids from Solid Matters, with or without attachment, for the perfect washing of the latter.

MAWSON & SWAN,
LABORATORY OUTFITTERS,
IMPORTERS & MAKERS OF PHILOSOPHICAL INSTRUMENTS, CHEMICAL, ELECTRICAL, AND OTHER APPARATUS.

MAWSON & SWAN have an extensive assortment of all kinds of Chemical and Scientific Apparatus, Pure Chemicals, and Reagents.

Sole Agents for the sale of BUNGE'S *Celebrated Balances and Weights of Precision.*

13 & 15 MOSLEY STREET
NEWCASTLE-ON-TYNE.

TOWNSON & MERCER,
89, Bishopsgate Street Within,
LONDON.
Wholesale and Export Dealers and Manufacturers of
CHEMICAL & SCIENTIFIC APPARATUS,
PURE CHEMICALS, &c.,
For Analysis and the general Laboratory Use of Manufacturers and Professors of Universities, Schools, Mines, &c.

Now ready,
TOWNSON & MERCER'S COMPLETE CATALOGUE of Chemical and Scientific Instruments, Pure Chemicals &c. Demy 8vo. Illustrated with upwards of 800 Woodcuts. Price 2s. 6d., post free.

Silicates of Soda and Potash in the state of Soluble Glass, or in CONCENTRATED SOLUTION of first quality, suited for the Manufacture of Soap and other purposes, supplied on best terms by W GOSSAGE and Sons, Soap Works, Widnes, Lancashire.
London Agents, COSTE and Co., 19 and 20, Water Lane, Tower Street, E.C., who hold stock ready for delivery

UNIVERSITY COLLEGE, LIVERPOOL.

The Council of University College, Liverpool, and of the Liverpool Royal Infirmary School of Medicine, are prepared to appoint a PROFESSOR OF EXPERIMENTAL PHYSICS in connection with the above Institutions. The stipend of the Professor will be £400 per annum, together with a share of the Fees. The holder of this Professorship will be required to give instruction in Mathematics until a separate Chair of Mathematics shall have been endowed, He will also be expected to deliver a Course of Lectures to Evening Classes.
Applications and testimonials to be sent in not later than June 20th, 1881, to either of the undermentioned.
W. J. Stewart, 25, Lord Street, Liverpool, R. Caton, M.D. 18A. Abercromby Square, Liverpool.
May 18, 1881.

MEETINGS FOR THE WEEK.

Monday, 13th.—Royal Geographical, 8.30.
Tuesday, 14th.—Medical and Chirurgical, 8.30.
Wednesday, 15th.—Meteorological, 7.
Thursday, 16.—Royal, 4.30.
— Philosophical Club, 6.30.
— Chemical, 8. "On the Isomeric Acids Obtained from the Ethers of Salicylic Aldehyd and from Coumarin," W. H. Perkin. "Notes on Napthalene Derivatives," H. E. Armstrong. "On the Synthetical Production of Ammonia," G. S. Johnson "On the Sulphates of Aluminium," Spencer Pickering. Ballot for the Election of Fellows.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

22, ALBEMARLE STREET, LONDON, W.

The next Annual General Meeting will be held at YORK, commencing on Wednesday, August 31.

President Elect.

SIR JOHN LUBBOCK, Bart., M.P., D.C.L., F.R.S.

Notice to Contributors of Memoirs.—Meetings of the Organising Committees for the several Sections will be held shortly, and Authors are requested to give notice of their intention to offer papers.

G. GRIFFITH, Acting Secretary.

Harrow, Middlesex.

SOUTH LONDON SCHOOL OF CHEMISTRY.

VACATION ARRANGEMENTS.

Gentlemen can be privately instructed in any branch of Practical Chemistry during the months of July, August, and September. Those desirous of working out any Research or Patent (with or without advice) can secure a Private Laboratory to themselves.—For terms apply to W. Baxter, Secretary, South London Central Public Laboratory, Kennington Cross, S.E.

MR. J. S. MERRY,

ASSAYER AND ANALYTICAL CHEMIST, SWANSEA.

Water-Glass, or Soluble Silicates of Soda and Potash, in large or small quantities, and either solid or in solution, at ROBERT RUMNEY'S Ardwick Chemical Works Manchester.

Wanted, to Purchase Volumes 1, 2, 3, 4, and 5 of the "Journal of Society of Telegraph Engineers."—Address, A. E. A., Chemical News Office, Boy Court, Ludgate Hill, London, E.C.

ROYAL POLYTECHNIC.—Lurline, the Rhine Maiden, by Mr. George Buckland.—Arctic Exploration, by Commander Cheyne, R.N.—Porcelain Manufacture, by Mr. J. D. Cogan.—The Photographer's Sunbeam, by Mr. T. C. Hepworth.—The Rising in the Transvaal, by Mr. W. R. May.—Etherdo, the Juggler.—The Microscope, Electricity, the Isle of Wight, &c., by Mr. J. L. King.—Fleuss's Diving Apparatus.—The Electric Railway.—Balmain's Luminous Paint Room.—Recitals by Mrs. Stirling and others, at 3 on Saturdays. Admission to the whole, 1s. Open from 12 till 5 and 7 till 10.

THE CHEMICAL NEWS AND JOURNAL OF PHYSICAL SCIENCE.

Edited by WILLIAM CROOKES, F.R.S.

Published every Friday. Price 4d. Annual Subscription, post free including Indices, £1

CHARGES FOR ADVERTISEMENTS.

	£	s.	
Five lines in column (about 10 words to line)	0	3	6
Each additional line	0	0	
Whole column	1	15	0
Whole page	3	0	0

A reduction made for a series of insertions

Cheques and Post-Office Orders, crossed "London and County Bank," payable to the order of William Crookes.

BOY COURT LUDGATE HILL LONDON, E.C.

BISULPHIDE OF CARBON

PROTOSULPHATE
RED OXIDE
OXYCHLORIDE
Sulphocyanide,
And every other Mercurial Preparation.

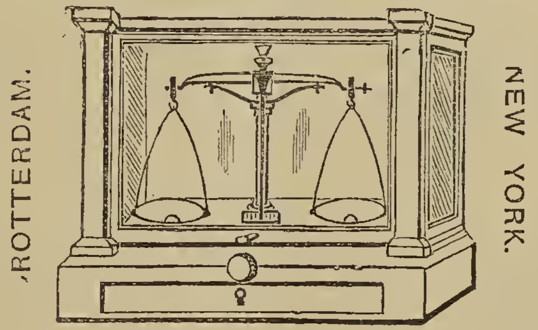
BISULPHITE OF LIME, TETRACHLORIDE OF CARBON.
Oxysulphuret of Antimony, Glacial Acetic Acid,

Liquor Ammoniæ,
Sulphide of Iron,
Pure Acids,
Chloride of Sulphur,
Acetone,
Chloroform,
Aldehyde,
Chlorate Baryta,
Arsenic Acids,
Fruit Essences for Confectionery & Liqueurs,
Perchloride of Iron,
Sulphite and Hyposulphite of Soda,
Phosphates of Soda and Ammonia,
Ethers,
Bromides,
Iodides,
Scale and Granular Preparations,
Sulphide of Sodium.

ALSO,
Pure Photographic Chemicals of every kind.
MANUFACTURED BY
WILLIAM BAILEY & SON,
HORSELEY FIELDS CHEMICAL WORKS,
WOLVERHAMPTON.

BECKER & SONS,

MANUFACTURERS OF
CHEMICAL AND GOLD ASSAY BALANCES
AND OTHER
SCALES AND WEIGHTS.



BECKER'S STUDENT'S BALANCE, in polished mahogany glass case, sliding front, counterpoised, to carry 30 grammes in each pan and turn to ½ milligramme, nickel plated pans £2 10
Ditto, ditto, in mahogany glass case, polished black.. .. .. £2 13

Sole Agents for England, Ireland, and Wales:—

TOWNSON & MERCER.

Becker's Complete Lists forwarded by post on receipt of 1*d.* stamp or free on application.

SILICATE OF SODA, Solid and in Solutions of Various Degrees of Concentration: the finest quality obtainable, and especially adapted for the use of Soap Makers and other Consumers.—JOSEPH CROSFIELD and SONS, Soap Makers, &c., Warrington.
London Agent—H. B. CLARKE, Great Tower Street, E.C.

TO GAS COMPANIES AND ANIMAL CHARCOAL MAKERS

Two Sets of Retorts, quite new, 9 ft. by 2 ft., completely fitted with pipes and hydraulic main, covers, and furnaces, TO BE SOLD very cheaply.—Apply to K. C. B., 22, Great St. Helens, London, E.C.

IRISH HILL BAUXITE (Alum Clay).

The **IRISH HILL MINING CO.** are now, and always have been, the LARGEST PRODUCERS OF THIS CLAY, of Superior Quality, and supply the Manufacturers of Alum, Sulphate of Alumina, and Alum-Cake, of the United Kingdom, America, and the Continent, almost exclusively.

ANALYSIS BY JOHN PATTINSON, ESQ.

	Dried at 212° F.		
	Gertrude (extra qual.)	1st Quality.	2nd Quality.
Alumina	59·00	53·83	52·00
Peroxide of Iron	0·47	1·57	4·57
Silica	18·00	8·67	12·00
Titanic Acid		5·80	6·20
Lime, Magnesia, Potash, Soda, and Sulphuric Acid	0·23	0·83	1·14
Combined Water	22·30	29·27	24·00
	100·00	99·97	99·91

Our MINES, DRYING KILNS, and GRINDING MILLS are situated very close to the Shipping Ports of BELFAST and LARNE, and adjacent to Railways running alongside both Steamers and Sailing Vessels at both Ports, from either of which shipping is abundant and cheap, therefore we can guarantee Regular Delivery as Buyers require it, and are prepared to quote prices f.o.b. c.i.f., or delivered at any Port, in Bulk or Bags, Lump or Ground.

GEO. G. BLACKWELL, *Managing Director.*

Richmond Buildings, 26, Chapel St.,
Liverpool.

ESTABLISHED 1798.

ROBERT DAGLISH & CO.,
ENGINEERS, BOILER AND BRIDGE MAKERS, MILLWRIGHTS,
BRASS AND IRON FOUNDERS.

Manufacturers of every description of Condensing, or High-pressure Blowing, Pumping, Rolling, Winding, and Patent Steam-engines, of any required power, for Irrigating, Draining, Mining, Rolling Mills, or Water Works purposes, and Manufacturers of every description of Chemical, Colliery, Copper Ore, Gold Mining, Glass, and Rock-salt Machinery.

Black-ash Revolving Furnaces of the Most Approved Type.

Bessemer Steel-Rail Plant.

Compressing-Engines for Collieries, Iron Works, and Weldon's Patent Bleaching-Powder Process.

Caustic, Chlorate, Decomposing, Nitre Nitro-Glycerine, Iodine Potash, Sulphur, Acid, and Oxalic Pans.

Gas Producers Patent for Heating and other Purposes.

Pyrites Burners for Irish, Norwegian, and Spanish Ores of Improved Construction.

Patent Rousing Machinery for Brewers.

Retorts, Acid, Gas, Iodine, Nitric, Nitre Nitro-Glycerine and Vitriol Refining.

Steam Superheaters improved for Oil, Tar, and Resin Refining.

Steam Sulphur Melter.

Stills for Oil, Resin, and Tar.

Wheels, Bevel, Mitre, and Spur Moulded on the Shortest Notice by Patent Machinery.

Makers of Mactear's Patent Carbonating Furnace, Jones and Walsh's Patent Sulphate of Soda Furnace, Parnell and Simpson's Patent Causticiser, and Kynaston's Patent Alum Plan

Lists sent on Application.

Photographs, Plans, and other information supplied on receipt of Order.

ST HELEN'S ENGINE, BOILER, AND BRIDGE WORKS AND FOUNDRY,
LANCASHIRE.

These Pumps are especially adapted for MINES, QUARRIES, DYE WORKS, BREWERIES, &c.

They are so simple in construction that repairs can be done by an ordinary mechanic.

BERNERS COLLEGE of CHEMISTRY.

Instruction and preparation in CHEMISTRY and the EXPERIMENTAL SCIENCES under the direction of Professor E. V. GARDNER, F.A.S., M.S.A.

The Class Rooms are open from 11 to 5 a.m. and from 7 to 10 p.m daily.

Especial facilities for persons preparing for Government and other examinations.

Private Pupils will find every convenience.

Analyses, Assays, and Practical Investigations connected with Patents, &c., conducted.

Prospectuses and full particulars on application to Prof Gardener at Berners College, 44, Berners-street W.

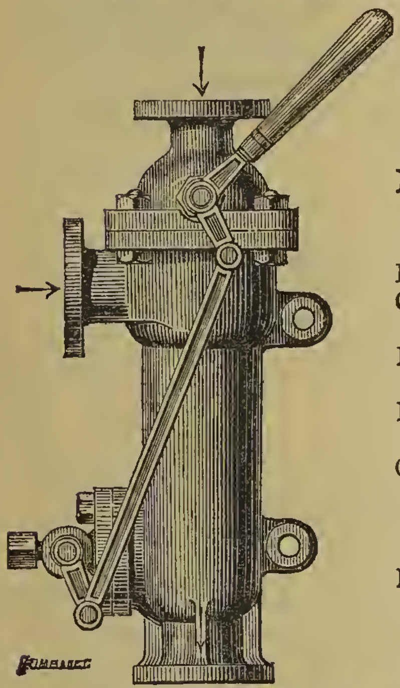
KÖRTING BROTHERS,

ENGINEERS,

17, LANCASTER AVENUE, FENNEL STREET,

MANCHESTER.

E. KÖRTING'S Patent Universal Injector



Works equally well non-lifting or lifting. Can be made to lift 24 ft. Works with high or low steam pressure. Works with hot or cold water. Forces the water into the boiler considerably above boiling point, thereby increasing the durability of the boiler.

IS STARTED BY SIMPLY TURNING ONE LEVER.

SUPPLIED TO:—

Belfast.	CORPORATION GAS WORKS	Leeds.	CORPORATION GAS WORKS.
Church.	FOXHILLBANK PRINTING Co.	Lincoln.	Messrs. ROBEY & Co.
Deptford.	Mr. A. J. DICKINSON.	London.	MAY & BAKER.
,,	R. WHEEN & SONS.	,,	MERRYWEATHER & SONS.
Dublin.	A. GUINNESS, SONS, & Co.	,,	VICTORIA GRAVING DOCK Co.
Glasgow.	LLOYD'S PROVING HOUSE.	Polmont.	NOBEL'S EXPLOSIVE Co., Lim.
,,	P. & W. MCCLELLAN.	Sittingbourne.	Mr. E. LLOYD.
,,	A. STEPHENS & SONS.	Sunderland.	The FORD WORKS Co.
,,	STEVENSON & Co.	Widnes.	GASKELL, DEACON, & Co.
Hebburn.	THARSIS SULPHUR Co.	,,	JAS. MUSPRATT & SONS.

Price Lists and Testimonials on Application.

EGLINTON ALUM CLAY

(SIMILAR TO, BUT CONTAINING LESS IRON THAN, BAUXITE).

THE EGLINTON CHEMICAL COMPANY, LIMITED, *who were the first to introduce this substance* to the notice of the Alum Trade, having shipped their first cargo of 100 tons in May, 1878, are now supplying it largely to ALUM MANUFACTURERS in this country and in America, Germany, and Russia, for the manufacture of Potash Alum and Sulphate of Alumina.

ANALYSIS OF DELIVERIES.

	Dried at 212° F.		
	Extra Quality.	First Quality.	Second Quality.
Alumina	65·00 p. ct.	52·37 p. ct.	43·41 p. ct.
Peroxide of Iron	0·50 ,,	1·29 ,,	1·81 ,,
Silica, &c.	4·50 ,,	19·24 ,,	34·35 ,,
Water of combination ...	30·00 ,,	27·13 ,,	20·52 ,,
	100·00	100·03	100·09

Being Shipowners, THE EGLINTON CHEMICAL CO., LIM., can guarantee regular delivery as may be required, and are prepared to quote a price f.o.b. at their private Harbours at Glenarm and Ballintoy; f.o.b. at Larne or Belfast; or delivered at Buyers' Works, in bulk or in bags, ground or unground.

WILLIAM J. A. DONALD, *Secretary and Manager.*

29, ST. VINCENT PLACE, GLASGOW.

London: Printed and Published for the Proprietor by Edwin John Davey, at the Office, Boy Court, Ludgate Hill E.C., June 10, 1881.

THE

CHEMICAL NEWS

AND

JOURNAL OF PHYSICAL SCIENCE

Edited by Wm. Crookes, F.R.S.] (WITH WHICH IS INCORPORATED THE "CHEMICAL GAZETTE") [Established Thirty-Eight Years.

Vol. 43.—No. 1125.] Copyright reserved. Friday, June 17, 1881. Registered as a Newspaper. [Price, 4d. Post Free, 4½d

CONTENTS.

CAPPER PASS AND SON, BRISTOL,

ARE BUYERS OF

LEAD ASHES, SULPHATE OF LEAD,
LEAD SLAGS, ANTIMONIAL LEAD,
COPPER MATTE, TIN ASHES, &c.,
and DROSS or ORES containing
COPPER, LEAD, AND ANTIMONY.

GRIFFIN'S
CHEMICAL HANDICRAFT.
SECOND EDITION.
Price 4s. 7d. post free.

A CATALOGUE OF CHEMICAL APPARATUS
ILLUSTRATED, CLASSIFIED, DESCRIPTIVE.
Demy 8vo., 480 pp., Illustrated with 1600 Woodcuts.
Most complete and cheapest List of Apparatus.

JOHN J. GRIFFIN and SONS, 22, Garrick Street, London, W.C.

INSTITUTE OF CHEMISTRY.

NOTICE.—Candidates for the Associateship who intend entering for the Practical Examination in Chemistry in connection with the Institute—to be held in August—are requested to send in their Certificates in General and Theoretical Chemistry, Physics, and Elementary Mathematics, before the 20th June.—Particulars can be obtained on application to the Secretary, Mr. Charles E. Groves, Somerset House Terrace, Strand, W.C.

THE VICTORIA UNIVERSITY,
MANCHESTER.

The Statutes and Regulations regarding Degrees, Examinations, and Courses of Study are now published. Students and others desirous of information may obtain copies on application to the Registrar.

R. ADAMSON, Registrar.

BRADY & MARTIN,
NEWCASTLE-ON-TYNE,

Will, on application, forward Catalogues of Chemical and Physical Apparatus, Pure Chemicals, Special Reagent Bottles with Embossed Labels, Nitrometer, &c., &c.

THE
Society of Chemical Industry.

NOTICE.

THE FIRST GENERAL MEETING
OF THE ABOVE SOCIETY
Will be held (by the kind permission of the President and Council) in the
ROOMS OF THE INSTITUTION OF CIVIL ENGINEERS
25, Great George St., Westminster, London, S.W.,
On Tuesday and Wednesday, the 28th and 29th inst.

The Chair will be taken by
PROFESSOR ROSCOE, F.R.S.,
At 11 o'clock in the forenoon of each day, and the meeting will be continued until 4.30 p.m., with an interval of half an hour, from 2 to 2.30 p.m.

The business of the Meeting will be as follows:—

A Report on the Prospects of the Society.
The President's Address.

And Papers on:—

Recent Legislation on Noxious Gases. By E. K. Muspratt, Esq.
The Use of Coal-Gas as a Heating Agent. By Dr. C. W. Siemens, F.R.S.
The Brewing of Lager-Beer. By Professor Charles Graham.
Mechanical Furnaces. By James Mactear, Esq.
The Patent Laws as applied to Chemical Inventions. By Ludwig Mond, Esq.
And other Communications.

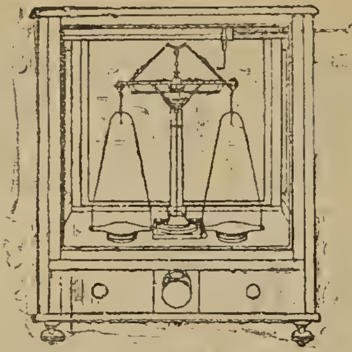
Members and their Friends will dine together at the Cannon Street Hotel on the evening of Tuesday, the 28th inst. Members desiring to attend the Dinner should make application for Tickets at once to Mr. Thos. Tyrer, Garden Wharf, Battersea, London, S.W.

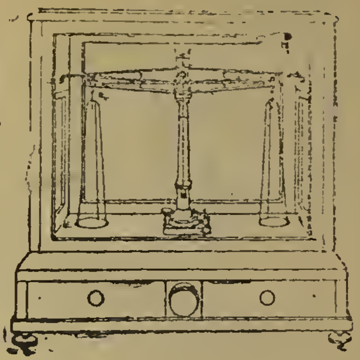
DINNER TICKET HALF-A-GUINEA,
exclusive of Wines.
EVENING DRESS OPTIONAL.
P.O. Orders payable to Mr. Tyrer, at Battersea Square Office.

Members having any communications to make to the Meeting are requested to send notices of the same to the Hon. General Secretary not later than the 24th inst.

Application for Membership may be sent to the undersigned,

GEORGE E. DAVIS, *Hon. General Secretary*,
Heaton Chapel, Stockport.





EGLINTON ALUM CLAY

(SIMILAR TO, BUT CONTAINING LESS IRON THAN, BAUXITE).

THE EGLINTON CHEMICAL COMPANY, LIMITED, *who were the first to introduce this substance* to the notice of the Alum Trade, having shipped their first cargoes of about 200 tons in April, 1875, are now supplying it largely to ALUM MANUFACTURERS in this country and in America, Germany, and Russia, for the manufacture of Potash Alum and Sulphate of Alumina.

ANALYSIS OF DELIVERIES.

	Dried at 212° F.		
	Extra Quality.	First Quality.	Second Quality.
Alumina	65·00 p. ct.	52·37 p. ct.	43·41 p. ct.
Peroxide of Iron	0·50 ,,	1·29 ,,	1·81 ,,
Silica, &c.	4·50 ,,	19·24 ,,	34·35 ,,
Water of combination ...	30·00 ,,	27·13 ,,	20·52 ,,
	100·00	100·03	100·09

Being Shipowners, THE EGLINTON CHEMICAL CO., LIM., can guarantee regular delivery as may be required, and are prepared to quote a price f.o.b. at their private Harbours at Glenarm and Ballintoy; f.o.b. at Larne or Belfast; or delivered at Buyers' Works, in bulk or in bags, ground or unground.

WILLIAM J. A. DONALD, *Secy. and Com. Man.*

29, St. Vincent Place, Glasgow.

CALVERT'S CARBOLIC TOOTH POWDER

NEWTON CRANE, Esq., late U.S. Consul, Manchester, says:—

"* * * Your Carbolic Tooth Powder is THE BEST I EVER USED. In this opinion I am joined by all the members of my family."

6d., 1s., and 1s. 6d. boxes at any Chemist's.

F. C. CALVERT & CO., MANCHESTER.

Awarded Nine Prize Medals and Diplomas.

CALVERT'S CARBOLIC DOG SOAP

Sixpenny Packets.

Mr. Newman, *of Aberllynfi, Glasbury, owner of the Champion Mastiff "Granby," says*:—"I consider your Carbolic Acid Dog Soap a very superior article for washing Dogs. It is effectual in its action, and easy to manipulate; I am very pleased with it."

F. C. CALVERT & CO., MANCHESTER.

Awarded Nine Prize Medals and Diplomas.

CALVERT'S No. 5 CARBOLIC 4 °/ₒ SOAP

1 lb. Bars. 4½d. each.

Highly effective for Laundry and Kitchen Uses; washes with hot, cold, or warm hard or soft water; and is a thorough cleanser and purifier of Linen, Flannels, Woodwork, or Painted Walls.

F. C. CALVERT & CO., MANCHESTER.

Awarded Nine Prize Medals and Diplomas.

JAMES WOOLLEY, SONS, & CO.,

69, MARKET STREET, MANCHESTER,

DEALERS IN

CHEMICAL AND SCIENTIFIC APPARATUS, CHEMICAL REAGENTS,

GERMAN GLASS AND PORCELAIN,

CHEMICAL THERMOMETERS, BOTTLES, LABELS, &c.,

FOR THE USE OF

ANALYSTS, SCIENCE TEACHERS & MANUFACTURERS

Price Lists on Application.

London: Printed and Published for the Proprietor by Edwin John Davey, at the Office, Boy Court, Ludgate Hill E.C. June 17, 1881.

SOCIETY OF GREAT BRITAIN

THE

CHEMICAL NEWS

AND

JOURNAL OF PHYSICAL SCIENCE

Edited by Wm. Crookes, F.R.S.] (WITH WHICH IS INCORPORATED THE "CHEMICAL GAZETTE") [*Established Thirty-Eight Years.*

Vol. 43.—No. 1126.] *Copyright reserved.* Friday, June 24, 1881. *Registered as a Newspaper.* [Price, 4d. Post Free, 4½d

CONTENTS.

CAPPER PASS AND SON, BRISTOL,

ARE BUYERS OF
LEAD ASHES, SULPHATE OF LEAD,
LEAD SLAGS, ANTIMONIAL LEAD,
COPPER MATTE, TIN ASHES, &c.,
and DROSS or ORES containing
COPPER, LEAD, AND ANTIMONY.

THE MASON SCIENCE COLLEGE,
BIRMINGHAM.

APPOINTMENT OF ASSISTANT LECTURER ON CHEMISTRY.

The Council invite APPLICATIONS, or or before the 18th of July next, for the above Appointment.

Particulars of the salary and conditions will be sent on application to the Secretary, Mr. G. H. Morley, the Mason Science College, Birmingham, to whom all applications for the Appointment should be sent.

By a resolution of the Council, Candidates are especially requested to abstain from canvassing.

J. GIBBS BLAKE, M.D., Chairman.
G. J. JOHNSON, Hon. Sec.
Edmund Street, Birmingham, June 15, 1881.

SOCIETY OF CHEMICAL INDUSTRY.

NOTICE IS HEREBY GIVEN, that the First General Meeting of the above Society will be held in London on Tuesday and Wednesday, the 28th and 29th of June, at which papers of great interest will be read, and discussions take place thereon.

The full particulars and programme of this meeting was advertised in these columns on the 18th of June.

Members and their friends will dine together on the evening of the 28th of June.

Gentlemen desirous of becoming Members of the Society are requested to communicate with Mr. THOS. TYRER, the Hon. Metropolitan Secretary, Garden Wharf, Battersea, London, S.W., or with the undersigned,

GEORGE E. DAVIS, Hon. General Secretary.
May 17, 1881. Heaton Chapel, Stockport.

BRADY & MARTIN,
NEWCASTLE-ON-TYNE,

Will, on application, forward Catalogues of Chemical and Physical Apparatus, Pure Chemicals Special Reagent Bottles with Embossed Labels, Nitrometer, &c., &c.

GRIFFIN'S
CHEMICAL HANDICRAFT.
SECOND EDITION.
Price 4s. 7d. post free.

A CATALOGUE OF CHEMICAL APPARATUS:
ILLUSTRATED, CLASSIFIED, DESCRIPTIVE.
Demy 8vo., 480 pp., Illustrated with 1600 Woodcuts.
Most complete and cheapest List of Apparatus.

JOHN J. GRIFFIN and SONS, 22, Garrick Street, London, W.C.

TO ANALYTICAL CHEMISTS OR MANUFACTURERS EMPLOYING CHEMISTS.

A Young Gentleman, who has passed second in Practical Chemistry at King's College (Evening Classes) two years running, desires an Engagement in a Laboratory. Highest references and excellent testimonial from late employer.—Address, Leo Taylor, Chapel House Street, St. Thomas's Square, Hackney.

TO MANUFACTURERS.

Engagement Wanted. Many years Practical, Chemical, Mechanical, and General Experience in the Management of Works and Workmen. Charge of a small chemical factory preferred. Willing to be useful in any capacity.—Address, "Nitric," Chemical News Office, Boy Court, Ludgate Hill, London, E.C.

Soapmaker wanted for the Colonies, with thorough knowledge of the Household and Soft Soap Trade. Must be well recommended.—Apply to George Bennie and Co., Kinning Park Foundry, Glasgow.

Wanted, for a Young Man who has had considerable experience in metallurgical processes and chemical analysis, an appointment in Works where his experience and energy could be utilised with a view to Partnership. Large available capital. —Apply, A. B. C., Chemical News Office, Boy Court, Ludgate Hill, London, E.C.

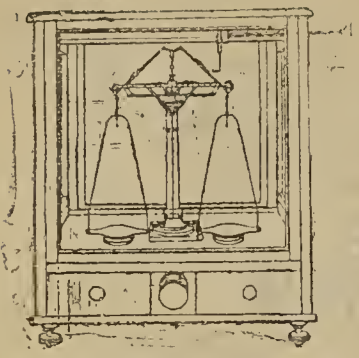
Wanted, a Strong Young Man thoroughly acquainted with the Chemical Apparatus Business, to attend to customers and help in warehouse.—Address, X., Chemical News Office, Boy Court, Ludgate Hill, London, E.C.

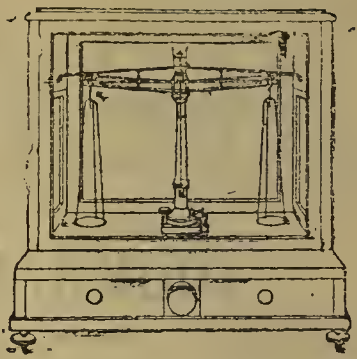
Wanted, by a Young Gentleman in his eighteenth year, who has prepared himself for such employment by a thoroughly systematic course of study in analytical chemistry in a well known laboratory, Employment as Assistant to the Manager of some manufacturing establishment. The advertiser's friends would be prepared to negotiate with any correspondent in a spirit of fairness.—Address, W. S., Raby House, Bathwick, Bath.

Wanted, a Foreman who thoroughly understands the manufacture of Animal Charcoal and the setting up and working of the necessary plant used.—Address, stating full particulars, "Omega," care of F. Algar, Esq., 11, Clement's Lane, London.

Wanted, immediately, Price Current of Purified Wood Naphtha (0·84 sp. gr.) to furnish in great quantities. Letters, post paid, 3577, Seyffardt's Advertisement Office, Amsterdam.

Wanted, to Purchase Volumes 1, 2, 3, 4, and 5 of the "Journal of Society of Telegraph Engineers."—Address, A. E. A., Chemical News Office, Boy Court, Ludgate Hill, London, E.C.





EGLINTON ALUM CLAY

(SIMILAR TO, BUT CONTAINING LESS IRON THAN, BAUXITE).

THE EGLINTON CHEMICAL COMPANY, Limited, *who were the first to introduce this substance* to the notice of the Alum Trade, having shipped their first cargoes of about 200 tons in April, 1875, are now supplying it largely to Alum Manufacturers in this country and in America, Germany, and Russia, for the manufacture of Potash Alum and Sulphate of Alumina.

ANALYSIS OF DELIVERIES.

	Dried at 212° F.		
	Extra Quality.	First Quality.	Second Quality.
Alumina	65·00 p. ct.	52·37 p. ct.	43·41 p. ct.
Peroxide of Iron	0·50 ,,	1·29 ,,	1·81 ,,
Silica, &c.	4·50 ,,	19·24 ,,	34·35 ,,
Water of combination ...	30·00 ,,	27·13 ,,	20·52 ,,
	100·00	100·03	100·09

Being Shipowners, THE EGLINTON CHEMICAL CO., Lim., can guarantee regular delivery as may be required, and are prepared to quote a price f.o.b. at their private Harbours at Glenarm and Ballintoy; f.o.b. at Larne or Belfast; or delivered at Buyers' Works, in bulk or in bags, ground or unground.

WILLIAM J. A. DONALD, *Secy. and Com. Man.*

29, St. Vincent Place, Glasgow.

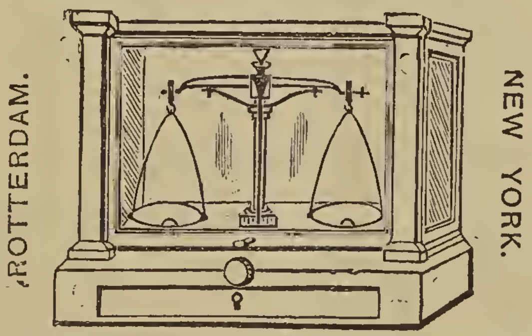
BISULPHIDE OF CARBON
PROTOSULPHATE
RED OXIDE
OXYCHLORIDE
Sulphocyanide,
And every other Mercurial Preparation.
BISULPHITE OF LIME, TETRACHLORIDE OF CARBON.
Oxysulphuret of Antimony, Glacial Acetic Acid,

Liquor Ammoniæ,
Sulphide of Iron,
Pure Acids,
Chloride of Sulphur,
Acetone,
Chloroform,
Aldehyde,
Chlorate Baryta,
Arsenic Acids,
Fruit Essences for Confectionery & Liqueurs,
Perchloride of Iron,
Sulphite and Hyposulphite of Soda,
Phosphates of Soda and Ammonia,
Ethers,
Bromides,
Iodides,
Scale and Granular Preparations,
Sulphide of Sodium.

ALSO,
Pure Photographic Chemicals of every kind.
MANUFACTURED BY
WILLIAM BAILEY & SON,
HORSELEY FIELDS CHEMICAL WORKS,
WOLVERHAMPTON.

SILICATE OF SODA, Solid and in Solutions of Various Degrees of Concentration: the finest quality obtainable, and especially adapted for the use of Soap Makers and other Consumers.—JOSEPH CROSFIELD and SONS, Soap Makers, &c., Warrington.
London Agent—H. B. CLARKE, Great Tower Street, E.C.

BECKER & SONS,
MANUFACTURERS OF
CHEMICAL AND GOLD ASSAY BALANCES
AND OTHER
SCALES AND WEIGHTS.



BECKER'S STUDENT'S BALANCE, in polished mahogany glass case, sliding front, counterpoised, to carry 30 grammes in each pan and turn to ½ milligramme, nickel plated pans £2 10
Ditto, ditto, in mahogany glass case, polished black.. .. .. £2 13

Sole Agents for England, Ireland, and Wales:—
TOWNSON & MERCER.
Becker's Complete Lists forwarded by post on receipt of 1d. stamp or free on application.

MR. J. S. MERRY,
ASSAYER AND ANALYTICAL CHEMIST.
SWANSEA.

Water-Glass, or Soluble Silicates of Soda and Potash, in large or small quantities, and either solid or in solution, at ROBERT RUMNEY'S Ardwick Chemical Works Manchester.

DOULTON & WATTS

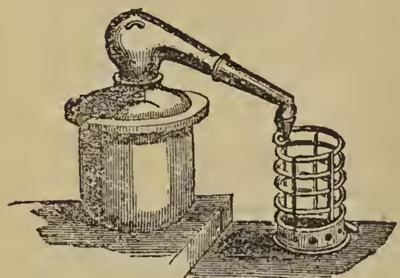
HIGH STREET, LAMBETH, LONDON, S.E.

MANUFACTURERS OF

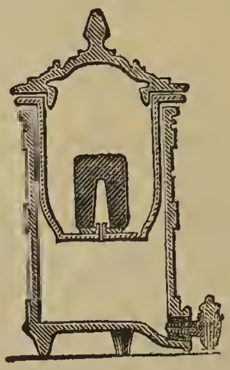
STILLS, RETORTS, CONDENSING WORMS, WOLFF'S BOTTLES, ACID PUMPS, COCKS, PERCOLATORS, AIR-TIGHT JARS.

And every description of Stoneware for Chemical Purposes, warranted to resist the strongest acids.

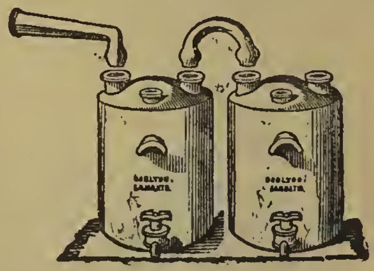
PLUMBAGO CRUCIBLES AND OTHER FIRE-STANDING GOODS.



DOULTONS, MANGANOUS



CARBON FILTER.



(Dr. Bernays's Patent).

The Patent Manganous Carbon Filter combines important improvements in construction which have been effected by Messrs. Doulton & Co., in conjunction with a valuable invention made by Dr Bernays, Professor of Chemistry at St. Thomas's Hospital; Public Analyst; Chemist to the Kent Water Works, &c., &c., &c.

NEW SHOW ROOMS, ALBERT EMBANKMENT, LAMBETH, S.E.

Depots :—Granville St., Birmingham; 100, Soho St., Liverpool; and 6, Rue de Paradis Poissonière, Paris.

WILLIAM AND WILLIAM T. FIELD,

MANUFACTURERS of the Celebrated STAFFORDSHIRE BLUE BRICKS, specially adapted for Chemical Plant, *i.e.*, Acid Towers, &c. Also all other kinds of Best Staffordshire Blue Bricks, Pavings, Plynths, Splays, Copings, & c &c. Prices and samples on Application.

TESTIMONIAL

"We have used the Blue Staffordshire Brick or Sulphuric Acid Towers, &c., manufactured by Messrs. Field, for the last fifteen years during which time they have given great satisfaction. We recommend them to the Chemical Trade, believing there is nothing better in the market."—(Signed) WILLIAM HUNT and SONS, Lea Brook Alkali Works, near Wednesbury, Staffordshire, February, 1878.

TOLL END BRICK-WORKS,
TIPTON, STAFFORDSHIRE.

MOTTERSHEAD & CO.,

7, Exchange Street and 10, Half Moon Street,
MANCHESTER.

CHEMICAL & PHYSICAL APPARATUS,
BOTTLES, PURE CHEMICALS,
REAGENTS, STANDARD SOLUTIONS,
And Every Requirement for Works' or School Laboratories or Private Students.

Illustrated Price Lists on application.

CHARLES LOWE & CO.,

(Established 1860.)

FACTORIES.
Reddish and Bradfoid,
MANCHESTER.
BRONZE MEDAL, PARIS, 1867.

TOWN OFFICES:
43, Piccadilly,
MANCHESTER.
GOLD MEDAL, PARIS, 1878.

MANUFACTURERS OF

Pure Carbolic Acid, Cryst. at 42°·2 C. } Discovered by C. Lowe
,, ,, do. Hydrate of
Medicinal do. Cryst. at 35° C.
Commercial do. No. 1 ,, 35° C.
,, do. 2 ,, 29° C.
,, do. 3 ,, 12° C.
,, do. 4 liquid at 0° C.
Carbolic Acid Disinfecting Powder.

Carbolic Acid Glycerine Solutions.
Cresylic Acid.
Sulpho-Phenic Acid (Cryst.)
Sulpho-Phenates & Sulpho-Cresylates of Soda, Potash, Zinc, Iron, and Alumina.

Benzol (Cryst.).
Anthracene.
Naphthaline.
Picric Acid (Cryst. and Paste).
Aurine (Rosolic Acid) Cake and Solution.

JOHN CLIFF,

STONEWARE MANUFACTURER,

Late JOHN CLIFF & Co.
Formerly STEPHEN GREEN.
of IMPERIAL POTTERIES,
LAMBETH.

OLD QUAY,
RUNCORN.

London: Printed and Published for the Proprietor by Edwin John Davey, at the Office, Boy Court, Ludgate Hill E.C.
June 24, 1881.

THE CHEMICAL NEWS,
VOLUME XLIII.
EDITED BY WILLIAM CROOKES, F.R.S., &c.
No. 1102.—JANUARY 7, 1881.

CONTRIBUTIONS TO THE HISTORY OF BLEACHING-POWDER.*

By GEORGE LUNGE, Ph.D., Professor of Technical Chemistry, Zurich.

Chloride of lime, or, as it is more commonly called, bleaching-powder, is a product of chemical manufacture which has for a long time past attracted the attention of chemists, not merely on account of its commercial importance, but also because its very chemical nature is to a great extent shrouded with far more mystery than we are accustomed to encounter, especially among inorganic compounds. It is even doubtful up to this moment whether we have to deal here with a true chemical compound only more or less mixed with accidental impurities, or whether it is from the process of its manufacture a mechanical mixture of several chemical compounds in certain proportions. The statements of the numerous investigators of bleaching-powder (which name I prefer to "chloride of lime," as not prejudging the question of its constitution) deviate from each other not merely in theoretical points, which would be natural enough, but also upon certain matters of fact, which should admit of a definite decision by means of experimental enquiry. In order to settle the fact as to some of the most important points in dispute between different chemists, I have, with the co-operation of one of my pupils, Mr. Schäppi, made an investigation, the results of which are summarised in what follows.

I shall not in this case, as is otherwise usual, set out with an enumeration of the literature on the constitution and formation of bleaching-powder—both because it would prove a very lengthy task and because the subject is very fully discussed in the third volume of my "Treatise on the Manufacture of Sulphuric Acid and Alkali," to which I must refer those who are more closely interested in the matter.

Our investigation touched the following points:—

I. What is the influence of the percentage of water in the lime on the formation of bleaching-powder?
II. What is the influence of air on bleaching-powder at high temperatures?
III. What is the action of carbon dioxide on bleaching-powder?
IV. How does the water contained in bleaching-powder behave?

I. *Influence of the Percentage of Water on the Formation of Bleaching-Powder.*—Two points are at issue here. First. Whether it is true that absolutely dry calcium hydrate does not absorb any chlorine? Second. With what percentage of water in the lime the strongest bleach can be made? With respect to both of these questions the statements of different chemists disagree most seriously. (The strongest bleach made in these experiments served for many of the later sets).

The lime for these experiments we endeavoured in the first place to prepare by calcining the purest Carrara marble in a Hessian crucible; but it proved very difficult to regulate the temperature so as to drive out nearly all the CO_2, without "burning" the lime "dead." Owing to this we preferred to use selected pieces of lime produced on the large scale, the analysis of which (made after slaking) proved its great purity:—

CaO	72·62
CO_2	0·51
Al_2O_3	0·06
SiO_2	not weighable
H_2O	27·80
	100·99

In a series of further estimations, made for each special chlorination, the CO_2 never exceeded 0·7, nor did it fall below 0·2 per cent

The following apparatus served for the treatment with chlorine. A circular plate of strong sheet-lead, 12 inches diameter, was provided with a double upright rim, 2¼ inches deep. The annular space between the two rims was filled with sulphuric acid of specific gravity 1·4, at which strength the acid neither absorbs nor gives up any sensible quantity of moisture at the ordinary temperature. A bell jar with a tubulated top dipped with its lower rim into the sulphuric acid, thus forming a hydraulic lute. The tubulus was provided with an india-rubber cork through which passed two glass tubes; one reaching half way down the bell jar, for introducing the chlorine; the other, ending just beneath the cork, for conveying the air and the excess of chlorine into a condenser charged with calcium hydrate and coke. Inside this apparatus the lime was spread in thin layers on flat glass dishes, sometimes only in one at a time, sometimes in several dishes separated from each other by a glass framework.

The percentages of water in the following are understood as comprising the water of hydration. The latter in pure CaO,H_2O amounts to 24·32 per cent; for the lime employed by us it is as nearly as possible = 23·5 per cent.

---

* A Paper read before the Newcastle-upon-Tyne Chemical Society, November 25, 1880.

The treatment with chlorine was always continued till no further absorption took place, as judged by the colour of the gas; the apparatus was then left to itself over night. The analyses were always made at least twice over, several times even more frequently, especially in the cases where strikingly high results were obtained.

a. Chlorine, completely dried by concentrated sulphuric acid, yielded the following products:—

Percentage of water in the lime employed.	Percentage of available chlorine in the bleach.
6·5	9·06
13·6	32·86
13·64	33·34
17·6	37·38
17·6	37·64
21·6	38·82
24·0	40·71
26·0	40·89
27·8	43·13
27·8	43·42
28·2	40·36
30·1	38·78
31·8	36·85

The following five samples were chlorinated at the same time under the same bell-jar, so that presumably the lime poorer in water attracted some of the water in the last sample:—

Percentage of water in the lime.	Available chlorine in the bleach.
6·5	12·49
13·6	35·38
21·6	40·18
24·0	43·09
41·0	20·34

b. Chlorine incompletely dried, by passing it through a tube, 3 feet 3 inches long, filled with dry pumice. This mechanical absorption of the water was intended to imitate as nearly as possible the superficial method of drying employed in the factories, where the gas is passed through a long range of pipes in which most of the water, along with the hydrochloric acid, is condensed by the cooling action of the air. In either case the chlorine contains at least the moisture corresponding to the existing temperature and pressure, and the result must be very nearly the same in both cases.

Water in the lime.	Available chlorine in the bleach.
24·0	42·12 per cent
26·0	41·59 „
28·2	40·54 „

c. Chlorine dried still less, viz., washed by water of 15° C. (59° F.), and passed at once into the bell-jar:—

Water in the lime.	Available chlorine in the bleach.
20·0	34·47 per cent
24·0	41·76 „
26·0	40·71 „

d. Damp chlorine, passed through water of 40° C.:—

Water in the lime.	Available chlorine in the bleach.
24·0	38·26 per cent
26·0	38·27 „
26·0	39·31 „

e. Damp chlorine, passed through water of from 75 to 80° C. (167° F. to 176° F.):—

Water in the lime.	Available chlorine in the bleach.
24·0	37·0 per cent
25·3	38·43 „
26·0	38·96 „

This bleach was no longer a dry powder, but was damp and lumpy.

These samples, treated once more with damp chlorine as before, did not become richer, but somewhat poorer in available chlorine.

f. Calcium hydrate, dried on the water-bath, containing 24·0 per cent H_2O, chlorinated along with ordinary slaked lime, containing 25·3 per cent H_2O, yielded—

	With perfectly dry chlorine.	With chlorine merely dried by pumice.
Lime with 24 p. c. H_2O ..	39·3	41·59 p.c. available Cl.
„ 25·3 „ ..	40·6	40·6 „ „

These experiments lead to the following conclusions:—

1st. The statement of Graham, Tschigianjanz, Fricke and Reimer, and others, *that perfectly dry calcium hydrate does not absorb any chlorine, is erroneous.* This agrees with Stahlschmidt and Kopfer. Free water is quite unnecessary in order to start the reaction; on the contrary, even in the presence of a large excess of $CaO,Ca(OH)_2$ absorbs a large quantity of dry chlorine, much more even than if the CaO present had to be considered as useless ballast. This is probably caused by the liberation of water in the reaction:—$CaO_2H_2+Cl_2=CaOCl_2+H_2O$; even if the bleaching compound itself should be a hydrate, which is not certain, the assumption is not excluded that it might be deprived of its water of hydration by the stronger affinity for it of calcium oxide.

2nd. *The strongest bleaching-powder can be made with dry chlorine* up to 43·42 per cent available chlorine. Damp chlorine, even when freed from HCl by washing, is not quite so good, but bleach of 42 per cent can be made even when merely superficially drying the chlorine by a 3 feet 3 inch passage through pumice, somewhat corresponding to the long ranges of pipes employed in factories.

3rd. *The strongest bleach is made when the total moisture amounts to about 4 per cent over and above the water of hydration of the lime.* When employing dry chlorine, this 4 per cent must be contained in the lime itself; with imperfectly dried chlorine, as in experiments (*b*) and (*f*), the lime should contain less, only about 0·5 to 1·0 per cent free water. That this conclusion actually applies to the conditions of manufacturing on the large scale is proved by thoroughly trustworthy information which I received from Mr. Schaffner, the manager of the celebrated Aussig works. There the moisture in the sifted lime is determined every day; in summer it is kept at 24·5 to 25, in winter at 25·5 per cent; the latter, because then the chlorine itself loses more moisture in the 200 feet of piping through which it has to pass. There is never any irregularity to speak of in the strength of the bleach obtained. Whilst formerly German bleach was usually weaker than English, now the trade reports state that the German consumers allow a somewhat higher price for home-made than for English bleach, because the former is more uniform in quality. Hence the exact regulation of the amount of water is evidently of the utmost importance in bleach-making. It could be so regulated with the greatest accuracy, if it was feasible on the large scale to work with dry chlorine and to introduce the lime with the precise amount of moisture; at least we, on the small scale, *invariably* obtained bleach of 42 to 43 per cent under these conditions.

4th. The statement made by a few observers, that stronger bleach is made when passing the gas through warm water, is certainly erroneous.

5th. Since bleaching-powder of 43 per cent available chlorine is always obtained, when working under the above conditions, no formula can be correct which involves less available chlorine than 43 per cent.

II. *Influence of Air on Bleaching-powder.*—The substance was exposed to air in a porcelain boat within a horizontal glass tube, which could be heated to any desired constant temperature by means of an air-bath, provided with a ga regulator. The thermometer was fixed close to the plac where the boat was, but evidently its indications must have been somewhat higher than the real temperature within the tube. One end of the latter was connected with a receiver containing a solution of potassium iodide, and a cylinder filled with water for receiving the residual gas. This cylinder was fixed with its mouth downwards; the tube conveying the gas passed through its cork and went right to the top, whilst a second tube, ending just above the cork and closed outside by a pinch-cock, served for aspirating the air and the gases by means of the outflowing water, and for transferring the residual gas into a Winkler's gas-burette. The other end of the horizontal tube containing the bleaching-powder was also provided with a pinch-cock; here the air could be introduced directly, or washed and dried. For those experiments where air saturated with moisture was to be employed the horizontal tube was provided with a side branch connected with a small flask containing water, and kept at the same temperature as the bleaching-powder tube, in the same air-bath

a. Experiments with moist air.—The bleaching-powder tested 43·09 per cent. After heating for two hours at 60° C. (140° F.) no sensible evolution of gas had taken place, but this commenced at 80° C. (176° F.) and was finished a little above this temperature, so that further heating at a higher temperature did not produce much effect. The escaping gas contained no chlorine or hypochlorous acid, but merely oxygen. The residue in the boat, when the heating had lasted long enough, showed no available chlorine at all, but 39·42 Cl as chloride and 2·99 as chlorate. The latter must have retained as much oxygen as corresponds to 14·95 $CaOCl_2$; the free oxygen is evolved by a splitting-up of the remaining $CaOCl_2$ into $CaCl_2$ and O. The assumption that all the oxygen comes from a secondary decomposition of the first-formed calcium chlorate is not excluded; but there is no reason why a direct splitting-up of $CaOCl_2$ should not be admitted.

b. Dry air, passed over bleach of 43·09 per cent at 38° to 42° C. for 44 hours. The escaping gas contained no sensible quantity of oxygen (except that of the air itself), but 4·73 per cent of the bleach as chlorine. In the residue there was 3·99 per cent Cl as chloride, 0·23 as chlorate, 34·78 as available chlorine.

c. Dry air, passed over bleach of 42·70 per cent at 100° to 105° C. for six hours. The escaping gas contained 0·87 per cent of the bleach as oxygen (corresponding to 3·86 Cl as $CaOCl_2$) and 14·94 per cent as chlorine; the residue contained 22·25 per cent chlorine as chloride, 3·51 as chlorate, 1·35 as available chlorine.

The experiments (II.) prove the following:—

1st. In *damp* air of about 80° C., bleaching-powder gives up much oxygen; all the chlorine remains in the residue, partly as chloride, partly as chlorate. The reactions are:—

$$CaOCl_2 = CaCl_2 + O \text{ and}$$
$$6CaOCl_2 = Ca(ClO_3)_2 + 5CaCl_2.$$

2nd. In *dry* air of about 100° C. bleaching-powder yields the same products as in damp air; but another portion of the bleaching compound is directly split up into lime and chlorine:—

$$CaOCl_2 = CaO + Cl_2.$$

III. *Treatment of Bleaching-Powder with Carbon Dioxide.*—The apparatus was similar to that employed in the preceding series; but there was no aspiration, the CO_2 (moist or dry) being introduced on one side, and the gases passing out of the other side, first through a potassium iodide receiver, in order to retain the Cl, then into a measuring tube for the gas, luted by a solution of sodium hydrate and provided with a stop-cock at the upper end. In this tube the oxygen was collected and afterwards submitted to analysis.

a. Dry CO_2 *of the ordinary temperature* was passed many days in succession over bleach of 43·09 per cent and of 32·8 per cent not specially dried. At first a very slight quantity of Cl (or ClOH) was given off, probably only so long as any moisture was present; then the action ceased, and nearly all the chlorine was found unchanged (in the available state) in the residue.

b. Dry CO_2 was passed over bleach from various sources *at higher temperatures*, with the following results:—

	Chlorine Escaping as such. Per cent.	Chlorine in the Residue. Available. Per cent.	As Chloride. Per cent.	As Chlorate: Per cent.
Laboratory bleach of 43·09 p.c., treated 40 minutes at 95 to 100° C.	34·20	1·31	6·14	1·00
English bleach of 34 p.c. (originally 39 p.c.), 1 hour at 100° C.	28·28	2·47	5·67	?*
The same, 2½ hours at 70 to 75° C. ..	30·48	0·34	4·98	0·74
The same, 3½ hours at 55 to 60° C. ..	25·3	—	—	—
The same, 2 hours at 70° C.	29·21	—	—	—
The same, 2 hours at 70° C.	28·41	—	—	—
The same, 2 hours at 70° C.	27·50	—	—	—
Swiss bleach of 34 p.c., 2 hours at 60° C., then ½ hour at 100° C.	29·75	0·58	3·45	0·89

c. Dry carbon dioxide, passed over bleaching-powder which was previously *thoroughly dried* by long standing over concentrated sulphuric acid, caused no change at the ordinary temperature. At 80° C. 2·66 per cent chlorine was given off; at 180° C. no chlorine, but much oxygen, evidently merely by the action of the heat itself.

d. Moist CO_2, acting on English bleach of 34 per cent at 70° C., evolved in an hour 29·58 per cent chlorine.

e. Calcium chloride, treated at 70° C. with CO_2, exactly like the above samples, did not yield a trace of chlorine. This was to be expected as a matter of course; but the check test was made in order to exclude any doubt whatsoever.

After all these results the conclusion seems unavoidable, *that no formula of bleaching-powder in which calcium chloride occurs can be correct*, since in the presence of as little moisture as is contained in strong bleach nearly all the chlorine is driven off at 70° C. by carbon dioxide. The small quantity of chlorine found in the residue as chloride is evidently partly free $CaCl_2$ already present in fresh bleach, partly that produced in the formation of a little chlorate. That in the absence of all moisture the action is very slight is no matter of surprise; but even very much moisture would not explain how calcium chloride can be decomposed by CO_2 with formation of free Cl. The matter is different in the case of bleach *solutions* where the compound $CaOCl_2$ seems to have split up into CaO_2Cl_2 and $CaCl_2$ (we have not ourselves gone into that question yet); here there is a *possibility* that CO_2 might drive off so much ClOH that its action on KI would equal that of the Cl just found, although it would contain only half the quantity of chlorine. But even in that case a corresponding quantity of $CaCl_2$ would be found in the residue, which our experiments distinctly disprove to be the case for *solid* bleach.[§] Hence the formulæ of Gay-Lussac, Kolb, Fresenius, Stahlschmidt, &c., are all impossible, whilst Odling's formula $Ca\begin{matrix}-Cl\\-OCl\end{matrix}$ suffices for explaining all the phenomena observed, and must be considered the right one.

IV. *Behaviour of the Water contained in Bleaching-Powder.*—The substance was contained in a boat within a glass tube, which was heated by a flat mouthed burner,

---

* There was chlorate present, but the estimation miscarried. With these small quantities the chlorate could not in any case be quite accurately estimated.

a slight current of perfectly dry air being aspirated through it all along. The water driven off was absorbed by a calcium chloride tube, the chlorine by a solution of KI, and the escaping oxygen was in one case estimated by analysing the gaseous residue containing the aspirated air.

a. Bleaching-powder heated to incipient fusion :—

	Water.	Chlorine.	Oxygen.
34 per cent English bleach yielded ..	16·33	8·49	4·01 per cent
Do.	16·54	7·64	— ,,
Do.	14·60	9·39	— ,,
Do.	16·51	5·41	— ,,
Do.	17·60	6·40	— ,,
Do.	16·00	5·47	— ,,
Do.	18·09	7·49	— ,,

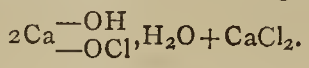
b. Bleach heated to the fritting point yielded 17·56 water; the same sample *heated with sodium carbonate* (as Stahlschmidt prescribes) yielded another 2·98 water, altogether 20·54 water, along with 7·67 per cent chlorine. Other samples of the same bleach were heated above the temperature employed before; after fritting the mass effervesced, evidently by the decomposition of chlorate, and then entered into a tranquil fusion. The glass tube (which was not of the most refractory kind) was softened, but the porcelain boat itself never got beyond a low red heat. In several experiments of this kind more than 20 per cent of water was driven off directly without adding sodium carbonate, which Stahlschmidt states to be necessary. A third sample of the same bleach was heated in a refractory glass tube, and yielded :—

In the air-bath at 150° C ..	14·21 per cent H_2O
,, ,, 200 ,, ..	0·29 ,, ,,
,, ,, 290 ,, ..	1·12 ,, ,,
At a bright red heat	5·35 ,, ,,
	20·97 ,, ,,

The laboratory-made bleach of 43·09 per cent, treated in a similar manner, of course yielded less water, viz. :—

At 180° C	12·24	12·29	11·98
At a red heat ..	4·79	4·86	4·95
	17·03	17·15	16·93

These experiments are incompatible with Stahlschmidt's theory, according to which the bleaching compound contains two-thirds of the water as water of hydration, and one-third as hydroxyl, his formula being :—



$$2Ca\begin{matrix}-OH\\-OCl\end{matrix},H_2O+CaCl_2.$$

The hydroxyl is supposed to be eliminated in the shape of water only by fusion with sodium carbonate. But, as we see, all the water can be driven off by heating without sodium carbonate, and that *without* observing an interruption in the rate of escape when just two-thirds of the water have gone away. It is true that the greater proportion of water goes away below 150°; then a pause ensues in which very little water escapes, the remainder going away above 290° C. But this behavior is identical with that of calcium hydrate, as proved by the following experiment. On heating slaked lime, containing altogether 31·5 per cent H_2O, there escaped :—

Below 150° C.	9·33 per cent H_2O
Between 150 and 290° C. ..	0·80 ,, ,,
From 290° C. to red heat ..	21·24 ,, ,,
	31·37 ,, ,,

Since the calcium hydrate was not absolutely pure, and a little carbonate was present as well, it is evident that the mechanically absorbed water escaped below 150°, the water of hydration only above 290°.

This seems to allow the conclusion, aided by the previous experiments, that the water driven off from the bleach above 290° C. belongs to *free calcium hydrate*, mechanically mixed with the bleaching compound ("chloride of lime"), whilst the water escaping at a lower temperature nearly all below 150° C., is either hygroscopic moisture, or belongs to a hydrate of the compound $CaOCl_2$, or is partly one and partly the other. The strongest bleach obtained yielded only very little water above that necessary for the compounds $CaOCl_2H_2O$, and $Ca(OH)_2$. But on standing over sulphuric acid at the ordinary temperature not merely all mechanically absorbed water, but over a portion of the H_2O of the hypothetical hydrate, $CaOCl_2H_2O$, is lost. Hence the existence of this hydrate, which is also disputed by Opl and Kopfer, is at least very doubtful.

The analysis of very good laboratory bleach yielded :—

39·89	per cent	CaO.
43·13	,,	available chlorine.
0·29	,,	Cl as $CaCl_2$ (corresponding to 0·07 O).
17·00	,,	H_2O (average of three estimations).
0·42	,,	CO_2
100·73	,,	(less 0·07 for oxygen).

From this the following composition can be computed :—

$CaOCl_2$	88·08 per cent
$CaCO_3$	0·96 ,,
$CaCl_2$	0·45 ,,
$Ca(OH)_2$	6·74 ,,
H_2O (by difference)	3·77 ,,
	100·00

The actual determination of the water yielded 0·66 more.

The comparatively small percentage of calcium hydrate found, viz., one-seventh of the calcium present as $CaOCl_2$, would seem to make it unnecessary to take it into account in a formula of bleaching-powder. From many other analogies there would be no difficulty in assuming that a certain quantity of calcium hydrate, varying according to circumstances, escapes the attack of the chlorine through being mechanically enveloped by the much larger bulk of the proper bleaching compound, $CaOCl_2$. Possibly the latter is somewhat protected against decomposition, (*e.g.*, by the atmospheric CO_2), by the calcium hydrates mechanically mixed with it, so that the part played by the latter is not an unessential one; but this would not lead to an alteration of Odling's formula on that account. The circumstance that good bleach, when ground up with a little water, swells up with evolution of heat, could be easily explained by the fact, that in this process $2CaOCl_2$ are changed into $Ca(OCl)_2 + CaCl_2$, which two compounds are assumed by most chemists to exist in *solutions* of bleach.

On the hand, there is one circumstance which would tend to show that the excess of lime should be represented in the formula of bleaching-powder. When the strongest bleach is ground up with water and the mixture is then diluted the insoluble residue does not appear in the pulverulent shape to be expected of previously formed, unchanged calcium hydrate, but in a flaky, voluminous form, similar to calcium hydrate just precipitated from a compound. This behaviour could be easily understood with Stahlschmidt's formula ($2CaOHOCl = CaO_2Cl_2 + CaO_2H_2$), but as we have seen, there are other insurmountable difficulties militating against this formula. Hitherto we have not found a sufficient explanation for this behaviour; but further experiments will be made in this direction.

Nitration of Salicylanilide.—C. Mensching.—This nitro-salicylanilide has been obtained by treating salicylanilide with nitric acid, melting at 244°. If the compound is treated with alkalies, and if the nitro-salicylic acid formed is isolated and converted into a barium salt, there is obtained the salt of *a*-meta-nitro-salicylic acid.—*Ber. der Deutsch. Chem. Ges.*

ON CHICKEN CHOLERA: STUDY OF THE CONDITIONS OF NON-RECIDIVATION AND OF SOME OTHER CHARACTERISTICS OF THIS DISEASE.*

By M. L. PASTEUR.

Concerning the properties of the extracts of the artificial cultivation of the germ of chicken cholera, an inquiry presents itself. We have shown that these extracts contain no substances capable of preventing the cultivation of the germs of this disease. They might, however, contain elements adapted to the vaccination of chickens. To investigate this point I have prepared cultivations where volume was not less than 120 c.c. After filtration and evaporation at a low temperature, while infinite care has been taken that its purity should not be affected, this liquid has given a dry extract, which was re-dissolved in 2 c.c. of water, and the totality of this was injected under the skin of a chicken which had never had chicken cholera. A few days afterwards the chicken, after being inoculated with a virus of the greatest virulence, died with the usual symptoms of *unvaccinated* chickens.

This class of experiments led to the following observation, which is of the greatest importance in physiology: When the extract from the cultivation of the germ of this disease, corresponding to an abundant development of the parasite, is injected under the skin of a fresh chicken in perfect health, the following phenomena take place: At first the chicken seems to suffer from a nervous disorder, which is indicated by panting breath and alternately opening and closing its beak; afterwards it becomes motionless, assumes the shape of a ball, refuses food, and seems overcome with drowsiness, as is the case with chickens affected with the disease. There is this difference, however, that the chicken wakes up at the least noise. This sleep lasts about four hours, after which the chicken wakes up, looks as well as usual, eats and cackles as if nothing had happened to it.

I have repeated this experiment several times and have always observed the same facts. Before injecting the extract above-mentioned, I took in every case the precaution of injecting an extract of the pure chicken broth, which does not cause analogous phenomena. I have, by this means, acquired the conviction that, during the life of the parasite, a narcotic is formed, and that it is this narcotic which causes the morbid symptom of sleep so characteristic of the disease which we are studying.

By the acts of its nutrition the germ of the disease causes grave disorders and brings on death. The germ, being aërobian, absorbs during its life large quantities of oxygen, and burns up many of the elements of its medium of cultivation. This may be seen by comparing the extract of the broth, before the development of the germ, with the extract of the liquid in which the development has taken place. Everything seems to show that it is from the globules of the blood that the oxygen necessary to its existence is derived by absorption through the tissues. While the chickens are still alive, even when death is still far off, their combs assume a violet tinge at a time when the germ of disease is so little diffused through the blood that it escapes microscopical examination. This species of asphyxia is one of the most curious traits of the disease we are studying. Death is caused by the grave disorders brought about by the development of the parasite in its body, by pericarditis, by serous extravasations, by alterations of its internal organs, by asphyxia, but the sleep characteristic of the disease is caused by a product formed during the life of the germ, which acts on the nervous centres. The independence of these two effects in the symptoms of this disease is further established by the fact the extract from a filtered cultivation of the germ acts as a narcotic on chickens which have been submitted to the *maximum* degree of vaccination.[*]

These facts will, doubtless, be found worthy of the meditations of pathologists.

Although I have taken already much of its time with this subject, the Academy will allow me to call its attention to some other characteristics of the disease called *chicken cholera*. We know that this disease is rapidly fatal, particularly if caused by a direct inoculation of its germ. It must then appear extraordinary that it sometimes presents itself in the chronic state, as in the case of inoculated chickens; which, after being severely ill, do not die, but seem to get relatively better. They eat, however, very little; they become anæmic, as shown in the discolouration of their combs; they continue to lose flesh, and finally die, after lingering for weeks or months. This fact would not be of primary importance if, at the death of the chicken the germ of the disease was not, in most cases, found in its body, which conclusively proves that the parasite has been present since the last inoculation, always active, although in a mild form, for it brings on death slowly. Doubtless, the germ was placed in some *vaccinated* portion unfavourable to its cultivation. Vaccinated chickens are most apt to present this form of disease, which is of very rare occurrence. We might be led to believe that, in this case, the virulent virus is changed into the attenuated, but this would be an error. In cases of this kind the virulence of the germ of the disease seems, on the contrary, to be aggravated. This may be easily seen by cultivating it artificially, so as to separate it from the blood, and inoculating it on fresh chickens.

Facts of this kind help us to understand the possibility of those long incubations of virus, such as that of rabies, for instance, which, after existing a long time in the body in a state which may be called latent, suddenly manifest their presence by the most marked virulence and by death. Do not these facts also throw light on human pathology? Alas! how often we see virulent diseases, such as scarlatina, measles, typhoid fever, followed by serious disorders of long duration, which are frequently incurable? The facts to which I have called attention are of the same nature, only here we can put our finger on their true cause.

I will conclude by pointing out another peculiarity, which is not less worthy of the attention of the medical profession.

In chickens in perfect health which have been thoroughly vaccinated there often occurs an abscess full of pus on some portion of the body, which does not seem to have any injurious effect on the health of the animal. It is a remarkable circumstance that this abscess is due to the germ of chicken cholera, which remains in it as in a closed vessel, and it cannot propagate, doubtless, because the chicken has been vaccinated. This germ may be withdrawn by artificial cultivation, or it may be directly inoculated on fresh chickens, which it kills in the usual manner after an abundant development. These facts recall the abscesses on guinea-pigs, which I have mentioned in the first communication on this subject, and they furnish a rational explanation of what happens in these abscesses. In all likelihood the muscles of the guinea-pig cultivate the germ more slowly and with greater difficulty than those of chickens; the disease is limited to an abscess, and recovery becomes possible.

I will now conclude this statement, as I have no wish to wear out the patience of this Academy. This subject is, however, so vast and so fruitful that I will ask its permission to bring the subject before it again. I have other observations to present to these. I will add those which will present themselves in the investigations I am now making.

---

[*] Translated from the *Comptes Rendus de l'Academie de Sciences*, of May 3rd, 1880, by P. Casamajor. The translation of the second paper of this series appeared in the Chemical News, vol. xlii., page 321 (December 31st, 1880).

[*] I should, however, try to isolate the narcotic, and see whether a sufficient quantity could cause death, and whether, in this case, the internal disorders would be the same as those of the disease itself.

"We would give nothing to the public," says Lavoisier, "if we waited until we reached the end of our researches, as these become broader and more extended the farther we advance."

A CRYSTALLISED DOUBLE SULPHATE OF LIME AND SODA.

By CHARLES W. FOLKARD.

In the Welsh process of manufacturing acetate of soda, during the evaporation of the liquor formed by the double decomposition of acetate of lime and sulphate of soda, a salt separates out in the form of micaceous spangles, which are greasy to the touch like steatite. They are of a light brown colour, due to tarry compounds dissolved in their mother-liquor. After removal of adhering acetate by alcohol, pressing between blotting-paper and drying over chloride of calcium, they have the following composition:—

	By Analysis.	Theory.
Ca	14·1	14·39
Na_2	16·8	16·55
$(SO_4)_2$..	68·7	69·06
	99·6	100·00

The above constituents were determined directly in the ordinary way, the loss being in part due to a trace of acetic acid, no doubt present as acetate of soda, which would account for the sodium being high. There was also a little water (0·3 per cent), probably in the form of mother-liquor in the interstices of the crystals.

On gentle ignition the salt is unchanged, but on heating to bright redness the crystalline form is destroyed. This seems strange, as it is anhydrous, and the bases and acids are fixed. It is probably due to the decomposition of the interstitial acetate of soda, the steam, &c. produced, possibly causing disruption of the crystals. At all events it seems difficult to account for the fact in any other way.

The salt is insoluble in alcohol and in concentrated solutions of acetate of soda, but is decomposed by weak solutions and by water.

Its formation is an essential part of the manufacture, and, therefore, an excess of sulphate of soda must be added to the acetate of lime solution. Sulphate of lime, being soluble to a certain extent in acetate of soda liquor, is not entirely precipitated in the double decomposition. This dissolved portion combines with the excess of sulphate of soda during the boiling down, and is precipitated as the double salt under consideration. It is in the form of mud (which sparkles in the sun, from the bright spangles of $CaNa_2(SO_4)_2$ which it contains), as soon as the liquor is sufficiently concentrated. If, however, there be no excess of sulphate of soda present, the dissolved sulphate of lime separates out in a jelly-like form on evaporation, and interferes altogether with the crystallisation.

If the separated mud be treated (preferably before cooling, as the strong solution crystallises into a solid mass) with methylated alcohol, it is found to consist of the crystalline double sulphate mixed with concentrated solution of acetate of soda. The greater part of the latter can be washed away by the alcohol, but the crystals always retain a little acetate of soda (about ½ per cent), doubtless, as mother-liquor between their layers, and from the very conditions of its formation and existence the salt cannot be purified from it.

On treatment with water or solution of acetate of soda of sp. gr. 1·150 and under, the salt is decomposed into sulphate of soda, which passes into solution and sulphate of lime, the latter, however, still containing soda.

The formation of this salt may explain why sulphate of lime obstinately retains sulphate of soda in double decomposition, which is only partially extracted even by boiling water. This is a source of considerable loss in certain manufacturing operations.

I have not been able to find any description of a salt of this composition crystallised in plates, although Watts mentions two or three double sulphates of lime and soda. An analogous compound of potassium and calcium is formed during the evaporation of tartaric acid liquors. It was described by Mr. Geo. H. Ogston, and contains—

$$K_2Ca(SO_4)_2 \cdot \tfrac{1}{2}aq.$$

Although the double sulphate of lime and soda is mentioned by Muspratt as being formed in the manufacture of acetate of soda, there is no description of it anywhere, so far as I am aware, and therefore it seemed to me that a short note on the subject might be of interest.

Ealing, December 28, 1880.

ON A THERMAL BALANCE.*

By Prof. S. P. LANGLEY.

Prof. Langley commenced, on the part of the Allegheny Observatory, with an account of a new instrument, invented by him and used there for measuring radiant heat, such as that from the sun or moon, or a distant terrestrial object. It was intended to replace the thermopile, which was used with effect by Melloni 40 years ago, but which had been little improved since, and was now insufficient for the numerous important investigations modern science needed in this direction. This new instrument, which he called provisionally "The Thermal Balance," was founded on a well-known principle, viz., that an electric current could be diminished by warming the wire through which it passed. Pyrometers on this plan had been made by Siemens and others. Nearly a year's experiment, however, had gone to producing the instrument exhibited, in which a quite new application of this principle had been made. Using a thermopile no power exists to move the index of the galvanometer, except the feeble energy which lies in the ray which warms the pile. In the new instrument a relatively powerful battery is employed, and the feeble radiant energy acts, not by its own weak force, but by controlling this great battery power, just as a weak human hand might control enormously greater power than its own when laid on the throttle valve of a steam engine. The thermal balance consists essentially of two series of delicate strips of excessively thin steel, platinum, or palladium, through which two equal currents pass. These opposite currents meet in a galvanometer, whose needle, pushed in opposite ways, by two equally powerful forces, remains motionless. Warming one of the sets of strips, by an almost inconceivably small amount would, it was shown, diminish the flow of electricity through the strips so warmed, and alter the index. As little change as a fifty-thousandth part of a Fahrenheit degree could be thus detected; and what was important, the instrument was not only far more sensitive than the thermopile, but far more prompt and very precise. Prof. Langley illustrated its delicacy by the statement that if placed in the reflecting telescope, it would indicate the heat from a man or other animal in a distant field. Except as far as the radiant heat might be absorbed by the air, it would, when thus directed, register that emitted by a cow, horse, or man at the distance of a quarter of a mile. As a more practical evidence of its utility to physicists, Prof. Langley gave tables of results in repeating Melloni's experiments' showing that the probable error of even a single measure in the latter case was less than 1 per cent., and concluded by an exhibition of measures on the heat of the moon made by it under the most diverse conditions, to test its real trustworthiness by this most delicate investigation.

---

* Abstract of a paper read before the National Academy of Sciences, New York.

ON THE
MEASUREMENT OF RADIANT ENERGY.*
By Prof. S. P. LANGLEY.

IN this paper Prof. Langley gave an account of some theoretically interesting results, reached by his thermal balance in measurements on the solar spectrum. No pure spectrum can be obtained by a prism owing to the absorption of the rays by its own material, but all the attempts of physicists to measure the exact distribution of energy in what is a pure spectrum, viz., that formed by what is called a "reflecting grating," had been hitherto baffled by its feeble character. Yet the question involved was of great theoretical importance, being nothing less than that of an experimental proof of the identity of heat and light, as merely different manifestations of the same radiant energy. Dr. John W. Draper, giving expression to the conception already in the minds of advanced thinkers long since, not only asserted this identity, but maintained, in opposition to almost universal authority at that time, that the heat and light curves were substantially identical; that heat did not give a maximum in the ultra-red, and that were it possible to make precise measures these facts could be demonstrated by methods more conclusive than any which were then known enabled him to use. Mr. Lewis M. Rutherfurd, of this city, had, by his extraordinary success in making accurate "gratings," surmounted one great part of this difficulty. He had generously put his rare skill in this direction at the service of any student of science who could profit by it, and it was, therefore, to him that they were largely indebted for the means of thus experimentally demonstrating the truth of Dr. Draper's views. The exact conclusions of the research undertaken by him must, Prof. Langley said, be deferred. It was now clear, however, that the curves representing the distribution of heat and light in the spectrum were substantially coincident, and the statements of eminent European authorities, who had taken too little account of American men of science, as represented by such names as those of Rutherfurd and Draper, must now be modified.

QUALITATIVE SEPARATION OF COBALT AND NICKEL.
By F. REICHEL.

THE circumstance that the detection of small quantities of cobalt in presence of nickel is tedious induced the author to utilise the solubility of the oxides of cobalt in concentrated potassa lye for this purpose.

If, in the course of analysis, a precipitate is obtained which may contain cobalt and nickel, it is not possible, if the nickel preponderates, to demonstrate the presence of cobalt by a simple blowpipe experiment. It is necessary to dissolve the precipitate, to add potassium nitrate, or to precipitate cobalt, if present, as hydroxide by means of a current of chlorine, and the subsequent addition of barium carbonate—an operation which requires several hours.

The author recommends to dissolve the precipitate, to throw down both metals with potassa lye, and place the precipitate on a filter. After the liquid is run off the precipitate, without washing, is introduced into a test-tube; a fragment of caustic potassa and very little water are added, and the whole is brought to a boil. The more concentrated the potassa solution the easier is the separation. The cobalt dissolves with a blue colour, and even very small quantities may thus be detected. The mixture is immediately filtered through a small asbestos filter, which should be in readiness, washing first with hot concentrated potassa lye and then with water. From the filtrate the cobalt may be precipitated as hydroxide by the addition of ether.—*Zeitschrift fur Analyt. Chemie.*

ON THE
GRAVIMETRIC METHOD OF DETERMINING PHOSPHORIC ACID.
By Dr. B. PEITZSCH, Dr. W. ROHN, and Dr. P. WAGNER.

THE authors recommend the following process, which has proved satisfactory in the experience of five years.

From 25 to 50 c.c. of the solution of the phosphate, which may contain from 0·1 to 0·15 grm. P_2O_5, are placed in a porcelain capsule with the addition of 100 to 150 c.c. molybdic solution. The mixture is heated on the water-bath, with occasional stirring, to about 80°, set aside for an hour, filtered through a plain filter, and the yellow precipitate (which need not be entirely rinsed on to the filter) is washed with dilute molybdic solution. The porcelain capsule is then placed under the funnel, the filter is pierced with a platinum wire, and the precipitate is washed into the capsule with dilute ammonia (2½ per cent), washing the filter-paper well, dissolved, stirring with the glass rod, and the solution washed into a beaker with ammonia of the same strength, enough of which is added to make up a volume of 100 c.c. About 15 c.c. of magnesium chloride mixture are then gradually dropped in, constantly stirring. After the mixture has been set aside for two hours, covered with a glass plate, it is filtered through a plain filter, the weight of the ash being known, and the precipitate is washed with dilute ammonia of the same strength till a portion of the filtrate, after being acidulated with nitric acid does not show the presence of chlorine with silver nitrate. The dried precipitate is separated from the filter, placed in a porcelain crucible; the paper is charred but not incinerated, and the char placed in the crucible, which is heated first gently, then ignited strongly for 10 minutes in a slanting position over a Bunsen burner, and finally exposed for 5 minutes to a blast-flame, let cool in the exsiccator, dried, and weighed.

The first 6 or 8 c.c. of the magnesia mixture should be added very cautiously.

The final ignition before the blast serves to volatilise any traces of molybdic acid which may have been precipitated.

The molybdic solution, dilute molybdic solution, and magnesium mixture should be prepared as recommended in the *Zeitschrift fur Analytische Chemie*, 12, 239.

PROCEEDINGS OF SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, December 14, 1880.

E. W. BINNEY, F.R.S., F.G.S., President of the Section, in the Chair.

"*The Land Subsidence at Northwich,*" by THOMAS WARD.

Having been an eye-witness of the great subsidence of land at Northwich, on December 6th, I will endeavour to explain how it arose. The district, of which Northwich is the centre, has two beds of rock salt underneath it. The first one, about 40 yards from the surface, is on the average 25 yards thick. Below this there is a bed of much indurated clay, about 10 yards thick, and below this again the bed of lower rock salt, some 35 yards thick. From 1670 to 1780 all the rock salt mined was obtained from the "Top Rock," as it is locally called, and the miners left too few supporting pillars, and these not large enough, besides working the salt out so as to leave only a comparatively thin crust of salt as a roof. The great majority of the mines in the Top Rock salt have fallen

---

[*] Abstract of a paper read before the National Academy of Sciences, New York.

wholly or partially. Since 1780 the rock salt has been "got" from the lower bed, and the pillars, especially of late years, have been left much larger, the roof at the same time being much thicker. Only from 5 to 6 yards of salt near the bottom of the bed has been worked. As a rule the mines in the bottom rock salt have stood firm, and where the owners have worked to their boundaries they have allowed the brine to run into the worked-out mines, thus converting them into reservoirs. The quantity of rock salt mined is small compared with the white salt manufactured. The white salt is made from a natural brine, which is found on the surface of the "Top Rock." It is found much cheaper to let the water do the mining and then pump up the salt in solution and drive off the water. The fresh water, as soon as it reaches the rock salt, eats it away till it gets fully saturated. This water running over the roofs of the old "Top Rock" mines has, in numbers of cases, eaten the whole of the salt away and opened a communication into the mine below. The overlying clays and earths, being deprived of their support, fall into the cavity thus opened, and a hole is made from the surface. On December 6th this was what occurred, and a hole or rift opened right across the course of the Wincham Brook, the water immediately rushing below. As the mines in both "Top" and "Bottom" rock were nearly exhausted of brine, the cavities to be filled were enormous. Directly beneath where the fall occurred, and bordering on an old-abandoned Bottom Mine, was a rock salt mine being worked. The barrier between the two having been on two occasions penetrated, it now gave way, and opened a communication with 15 acres of mine having a worked-out depth of about 18 ft. Into this mine, down a funnel of 100 yards in length from the surface, the water rushed with great velocity, causing the lower portion of the brook to retrace its course and drain off a large body of water from the River Weaver and an adjoining lake called the Top of the Brook. This immense body of water, rushing into the underground cavities, drove out the air contained therein, and so violent was the compression of the air, that it forced its way through every portion of the contiguous district that was in the least rifted or weak, showing itself in violent ebullitions in all the neighbouring pits, and where the earth was fractured causing a number of miniature mud geysers of 10 to 12-ft. in height. Much property was seriously damaged, and a considerable piece of land covered with water. Five sets of salt works are stopped owing to the destruction of a road and the pipes conveying the brine from the pumping district to the works. The greatest sufferers by this subsidence had little to do in causing it, and this is one of the great anomalies of the system of obtaining salt. The property of numbers of persons in no way connected with the salt trade is seriously injured, and under the existing law no compensation can be obtained.

This great subsidence is interesting from a geological point of view, as showing the action of natural forces, and illustrating how change of surface may occur. A counterpart of the Old Salt Lake of Triassic times is in process of formation.

"*Some endeavours to ascertain the nature of the insoluble form of Soda existing in the residue left on Causticising Sodium Carbonate Solutions with Lime*" (Part II.), by Watson Smith, F.C.S., Assistant Lecturer on Chemistry in the Owens College, and Mr. W. T. Liddle. Communicated by Professor C. Schorlemmer, F.R.S.

At the close of our last paper we mentioned that it was our intention to try certain further experiments with the crystalline precipitate obtained by mixing solutions of sodium carbonate and lime water and warming, and also with ordinary "*lime mud*" from the causticising pan of an alkali works, after the usual washing and draining. The experiments we proposed to try were:

(1) The effect of ignition upon the crystalline precipitate prepared as above, and upon the "*lime mud*" of the soda works.

(2) The effect of long continued boiling with water.

(3) The effect of boiling with some saline solution, as for example, with sodium sulphide.

Two fresh samples of the crystalline precipitate were now prepared, each in rather a different manner from the other. In the first case lime water was used in slight excess, and the sodium carbonate solution was dilute; in the second a strong solution of sodium carbonate was employed, the sodium carbonate being in excess. The precipitates obtained in both cases appeared under the microscope similarly crystalline; we will call them A and B respectively. On analysis the following results were obtained, after the precipitates had been washed with hot water till quite free from all soluble alkali:

	A.		B.
Calcium carbonate ..	98·07	per cent......	98·11
Sodium carbonate ..	1·93	"	1·88
	100·00		99·99

(1) A weighed quantity of dried precipitate, previously well washed from all soluble alkalinity, was now ignited strongly for about an hour, subsequently treated with dilute spirits of wine (water and alcohol, 5 : 2) filtered, washed well, any little lime in the filtrate precipitated, again filtered, washed, and the filtrate finally evaporated to dryness and weighed. Thus it was found that every trace of soda was extracted from the substance, both by examining the perfectly white sodium carbonate obtained, qualitatively, and also the residue of calcium carbonate with the spectroscope. The weight of Na_2CO_3 extracted was found to be 2·00 per cent, closely agreeing with the amounts determined. (See above analyses, A and B.)

(2.) A weighed quantity of the crystalline precipitate was now subjected to a six-hours' continuous boiling with water, adding water from time to time to replace that evaporated. By this means 1·7 per cent Na_2CO_3 was extracted, leaving about 0·2 per cent Na_2CO_3 in the residue, which the six-hours' boiling therefore failed to remove. The residue on spectroscopic examination showed that soda still remained behind. Doubtless another hour's boiling would entirely remove it.

(3.) The effect of boiling for six hours with a solution of sodium sulphide, obtained by lixiviating the mass resulting after fusing a mixture of ordinary salt-cake and charcoal, showed us that by this means much less soda is extracted than when pure water is used. The six-hours' boiling extracted only 0·5 per cent Na_2CO_3, thus leaving about 1·4 per cent insoluble in the residue. The crystalline precipitates we obtained as described were anhydrous, as the analyses show.

With regard to the *lime-mud*, the soda insoluble in water, and which long washing with hot water could not remove, was found in another sample of the mud to be 2·10 per cent Na_2CO_3, the amount of soluble alkali = 2·62 per cent, giving a total content of soda as—

2·10	per cent	Na_2CO_3	insoluble
2·62	"	"	soluble
4·72	"	"	total.

The water in the lime-mud was estimated by heating to 110° in a current of hydrogen till a constant weight was obtained. Thus 34·6 per cent of water was found, and calculating now on *dry residue*, we get as—

Na_2CO_3	insoluble,	3·21	per cent
"	soluble,	4·00	"
"	total	7·21	

(1.) After first washing a weighed quantity of the lime-mud, passing CO_2 to convert any lime into carbonate, and washing again to remove soluble alkali, the residue was ignited for an hour strongly, and then after a thorough washing with dilute alcohol, precipitation of any dissolved lime in filtrate, determination of soda obtained, and spectroscopic examination of residue, we found all soda was thus removed. This result agrees with that obtained by ignition of the precipitates we prepared. Kynaston found the same many years ago, in some examinations of lime-sludge, and hence we can quite confirm his results.

(2) The experiment was now tried of boiling a weighed quantity of the mud (having first passed CO_2), for six hours continuously with water, from time to time replacing what was lost by evaporation. The whole was now filtered and washed thoroughly, the filtrate being carefully evaporated to dryness. The residue gave a slight soda reaction in the flame, and was dissolved in hydrochloric acid, lime, and other bodies precipitated (a little iron and alumina with ammonia, and the calcium as oxalate), and then this filtrate was also evaporated to dryness. By this means it was found that practically all the soda was extracted by the prolonged boiling, the amount left behind being inappreciable.

It may now be interesting to mention that Fritzsche in 1864 (*Journ. für Prakt. Chem.*, 93, 339) succeeded in obtaining crystals artificially of the body till then only known as a mineral under the name of "*Gay Lussite.*" These crystals he obtained by the action of a boiling solution of sodium carbonate upon a smaller quantity of a solution of calcium chloride of 1·13 sp. gr., and letting the whole stand for some days. The analyses of these crystals showed them to consist, as Gay-Lussite does, of $CaCO_3,Na_2CO_3 + 5H_2O$. On heating with water the body is decomposed, sodium carbonate being dissolved and calcium carbonate being left behind. It was also found that the salt, when dehydrated, is more easily and quickly decomposed by water than before dehydration, and it would appear in fact as if the calcium carbonate and sodium carbonate were simply held together by the water of crystallisation.

When Fritzsche came to analyse the crystalline body he obtained, he attempted it by washing out the sodium carbonate, igniting the residue of calcium carbonate, and weighing the calcium oxide remaining after the ignition. On testing the residue by solution in very little hydrochloric acid, a very small evolution of carbon dioxide was observed, and this led to further examination, resulting in the discovery of a small quantity of sodium carbonate which had remained insoluble with the calcium carbonate. Fritzsche promised to experiment further in this new direction, but it does not appear that he has. Nevertheless, the results he obtained show that in two experiments the quantities of sodium carbonate retained as insoluble in the calcium carbonate residue, after careful washing, were, (1st) 1·8 per cent, (2nd) 2·4 per cent, thus closely agreeing with the amounts we found in our crystalline precipitates, the anlayses of which are given above.

Of course we are aware that several speculations might be advanced to account for the occurrence of the soda in the calcium carbonate in the insoluble form, but it seems to us most in accordance with the results we have obtained, with others, to view it as combined with an equivalent proportion of calcium carbonate, an insoluble compound being formed.

The practical bearing of our results would seem to be upon (1) the "causticising process," and (2) on the "black ash" process of the soda manufacturer, In the first case, as already mentioned, the residual soda is kept in circulation in the process, and so is not lost, the lime-mud being drained, and used again in the black-ash mixture. In some works, however, where black-ash is not made, *e.g.*, soap works, causticising from soda-ash, &c., an average loss of about 7¼ per cent Na_2CO_3 of the dry residue, or 4·7 per cent of the washed and well-drained mud, is sustained. In the second case, it is evident that an adequate improvement, by which a minimum amount of calcium carbonate is used in the black-ash mixtures, must effect an improved yield of soda or lixiviation, a smaller retention as insoluble compound in the soda-waste occurring. Wright's results and remarks on this head are valuable. (See his paper, already cited—Part I).

NOTICES OF BOOKS.

A Theoretical and Practical Treatise on the Manufacture of Sulphuric Acid and of Alkali, with the Collateral Branches. By George Lunge, Ph.D., F.C.S. Vol. III. London: John Van Voorst.

We have here before us the third and last volume of Dr. Lunge's great and valuable work. Here he discusses the ammoniacal soda-process, the manufacture of soda from cryolite, and gives an account of the applications of soda, and the statistics of the trade. Turning then to the most important of the secondary products, he considers the manufacture of chlorine by the ordinary process and the preparation of bleaching-powder. He next passes in review a variety of other processes for the manufacture of chlorine, and describes the proposals for the utilisation of still-liquor. The celebrated improvements of Weldon and Deacon form the subject of two chapters. We have next an account of various bleach-liquors, such as the chlorides of potash, alumina, magnesia, &c., compounds which, though possessing certain advantages, have not come into very extensive use. Dr. Lunge then treats of the analysis of bleaching compounds, by the processes of Gay-Lussac, Graham and Otto, Bunsen and Wagner, Penot and Davis. The tenth and last chapter is devoted to the chlorates of potash. There are two appendices, one giving an estimate of the cost of erecting an alkali works, with ground-plan, &c., and the second comprising addenda to the three volumes.

Certain portions of the work must now claim more especial attention. No small importance is naturally to be accorded to Dr. Lunge's verdict on the ammonia process. Supposing that the plant and apparatus required could be everywhere obtained in perfection, would the manufacture of soda by the Leblanc process have to cease? It is admitted that the soda made by Solvay himself is cheaper than soda of equal strength made in the same place. "But," remarks Dr. Lunge, "in England it appears that the ammonia-ash can only compete with the ordinary ash owing to its superior quality, which causes it to be saleable at a considerably higher price where purity is a first object. Where the latter is not of such importance the ordinary alkali securely keeps its place in this country as yet. He points out, further, that the manufacture of caustic, which cannot be well combined with the ammonia process, has risen to great importance, and cannot be lightly abandoned. Soda crystals also are made more readily by the old process, now that the cyanide and sulphide can be almost completely removed from the tank-liquor.

In Germany and France the author considers that the Solvay process will spread to a tolerable extent, especially where strong brine-springs exist near coal formations. But' on the other hand, have to be considered the bulkier state of the Solvay soda and the non-production of hydrochloric acid. The former of these obstacles, Dr. Lunge thinks, will probably be got over, but as yet there is no promise of making hydrochloric acid cheaply from calcium or magnesium chloride. Hence, where the cost of alkali and hydrochloric acid together is higher by the Solvay than by the Leblanc process, the latter will still predominate. It is further remarked that recently the German alkali makers have learned to turn out their ash *fully* equal in colour and strength to the best ammonia ash." Parenthetically, we beg to ask whether our English manufacturers have been equally successful?

It is also urged that a very great extension of the Solvay process would cause a very serious rise in the price of ammonia. In the best-managed works on the new system the loss amounts to 5 per cent. of ammonium sulphate on the total soda produced. If we take the total production of soda in Great Britain at 450,000 tons, and consider that, according to the calculation of Prof. Roscoe, the yield of ammonia obtainable from all the gas-liquor in the island is only 9000 tons, we shall see that, were the Solvay process to become universal, the cost of ammonia would soon reach a prohibitive figure. As regards the various proposals for obtaining ammonia artificially from atmospheric nitrogen, it may be said that none of them can yet be pronounced fully successful from a commercial point of view. Hopes may, perhaps, be entertained concerning Rickman's process.

The Weldon process is described very thoroughly and with full appreciation of the inventor's merit. The author states that 90 per cent. of all the bleaching-powder manufactured in Great Britain is made on the Weldon method, and on the Continent it prevails exclusively, save in one establishment in Germany where the Deacon process is at work.

The Deacon process, simple and beautiful as it seems, has not in the long-run given satisfactory results. It is mentioned that a manufacturer, who had laid out £16,000 in plant for this process, was compelled to discontinue it. The favourable reports he heard of the working at Messrs. Gaskell, Deacon, and Co.'s establishment led him to pay a visit of examination at the end of 1878, but what he saw had not the effect of inducing him to re-commence. The process is said to be in successful use in a Berlin factory for making chlorate of potash, but none of Mr. Deacon's apparatus is employed.

It is, we think, impossible to read through this work carefully without nothing the enormous strides which, within the last sixteen years, have been made by chemical manufactures in France and Germany. The author remarks, in his preface to the present volume, that when he first left his native country for England "the manufacture of sulphuric acid, soda-ash, and bleaching-powder was quite insignificant in Germany and not very considerable in France, as compared with Great Britain, nor could the technical appliances, the yields, or even the purity of the products in the two former countries vie with those of the latter. How different matters are now is a matter of notoriety. Many of the chemicals of those countries outstrip those of English works in purity; and their plant and their processes are frequently superior to those used in the majority of English works. Everybody knows how this has come about. The foreign chemists and manufacturers have looked all round, not merely in their own countries, but wherever they could find improved methods and apparatus; and, upon the practical knowledge thus gained, they have brought to bear the scientific training they had received at their universities and polytechnic schools. Thus they have already, in many fields formerly remunerative to British manufacturers, distanced the latter, immensely aided though these be by their long occupation of the ground and by permanent natural advantages, such as cheapness of coal and freight, superior command of capital; and this is likely to go on to an increasing extent if many British chemical manufacturers decline to profit from a scientific study of their respective branches. This is all the less excusable as England from of old has been a stronghold of scientific chemistry, and can hold its own against the whole world in this respect."

Might it not be worth our while to lay to heart these words of a friendly foreigner?

An exceedingly valuable feature of Dr. Lunge's work, in our opinion, is that he lays before his readers the methods of manufacture practised in France, Germany, Austria, and Belgium, as well as those followed in Britain. Another merit is that, whilst giving its due importance to practice, he does not overlook theory. He remarks, somewhat drily, that "several costly books, on perhaps the most important branch of chemical industry, has just been published with next to no chemistry in them." We hope that Dr. Lunge's work will be studied in the same spirit in which it is written, so that his readers, whilst looking for "practical hints," will not neglect fundamental principles.

The Atomic Theory. By Ad. Wurtz. Translated by E. Cleminshaw, F.C.S., F.I.C. London: C. Kegan Paul and Co.

If we compare the present work with that of Daubeny on the Atomic Theory, now long ago superseded, we shall be able to see what real and also what imaginary advance has been made in the philosophy of chemistry during the last quarter of a century.

The illustrious author sets out with a historical introduction, in which the labours of Proust, Richter, and Dalton are duly appreciated. He next passes to Gay-Lussac's law of volumes, the hypotheses of Avogadro and Ampère, and to the corpuscular theory of Berzelius. We next come to a discussion of Prout's hypothesis, the law of specific heats as developed by Dulong and Petit; isomorphism and the atomic weights of Berzelius; the objections to his principle of notation and remarks on the inconsistencies of the "equivalent" notation. In his fifth chapter the author examines the present system of atomic weights as established by the labours of Gerhardt, Laurent, and Cannizaro. The sixth chapter may be considered the most important part of the entire work, as in it the author examines the "periodic" classification of the elements introduced by Mendeleeff and Lothar Meyer. We propose to furnish an abstract of his critique elsewhere. Next follows an account of H. Kopp's researches on the molecular volumes of salts. The second book deals with atomicity, beginning with the definition and historical development of the idea. Prof. Wurtz treats of affinity and atomicity as two distinct properties of atoms. He applies atomicity to the interpretation of isomers and of molecular dyssymmetry The work concludes with a survey of hypotheses on the constitution of matter,—a question possibly beyond the scope of the human intellect. The author considers the conception of vortex atoms as of all hypotheses on the nature of atoms apparently the most probable. He considers the idea, however, as not absolutely new, but as having been originally conceived by Descartes. No one who aspires to an understanding of the more advanced chemical and physical speculation of the present day can afford to ignore this volume, which may be advantageously studied in conjunction with the opposite views of Prof. Kolbe and of the late Prof. Mohr, the representatives of what some may call the conservative phase of chemistry.

London Smoke and Fog; with some observations on the Country Parson's Grate and other Modern Fire-Places; being a chapter from the Author's new edition of his work on the Ventilation of Dwelling-Houses and the Utilisation of Waste Heat from Open Fire-Places. By Frederick Edwards. London: Longmans, Green, and Co.

We have here a small book, with a long title, on a very important subject. That London fogs are a nuisance we all know, and even without the testimony of Dr. Carpenter, of Croydon, the public is not entirely ignorant that we may leave a village ten or twelve miles off with clear air and sunshine and enter gradually an atmosphere that is utterly repulsive." But where is the remedy?

In some matters we are rightly told that if every man would reform himself the whole would be reformed. But as regards the smoke question, only the man who has a permanent interest in the house he occupies, and who has a tolerable balance at his bankers, can reform himself. And such men are relatively so few that if they each and all adopted the most approved means of smoke-consumption the improvement in most parts of London would be inappreciable.

The author reviews the various remedies proposed, such as the use of gas and of anthracite as fuel, and the absurd scheme of a tax on all open fire-places. Absurd we call this suggestion, because the ordinary house-occupier has not the right, and in many cases not the means, to make the alteration.

He then brings forward a plan which we cannot view without very grave doubts. He revives, namely, the scheme of John Cutler and of Dr. Neil Arnot, of burning a fire from the top downwards, and apparently of feeding it from below. This method would, of course, require the remodelling of all the fire-places in a house. We should fear that to light fires on this principle would prove exceedingly difficult, and that there would be considerable trouble in using them for cooking purposes.

In several respects we have actually retrograded in the construction of fire-places. The old-fashioned grates had no iron about them, save the bottom and front bars; all else was fire-brick. The great object of a modern fire-grate-maker is to employ, and consequently to sell, the greatest possible quantity of cast-iron. The kitchen-ranges generally used throughout the south of England are deplorable, the oven being heated not from the bottom, but from the top. Nor can any praise be given to the so-called "kitcheners," where the fire-box is small and the fuel is burnt at a temperature more suitable for metallurgical than for culinary operations. They sin, further, in having the fire surrounded with metal in place of fire-clay.

In criticising the Norwich stove, Mr. Edwards remarks very justly "it may be said that the regulator should be carefully graduated by the housemaid after she has lighted the fire, but in all probability there is not one housemaid in a thousand, or perhaps a hundred thousand, who understands its use and cares anything at all about the matter." We suspect that these same remarks would be found applicable to his proposal of lighting a fire at the top. Not one housemaid in a hundred thousand could do it, or would be willing to try. The fact is that to reform our fires we should have to begin at the beginning. So long as our houses are run up by speculative builders, who make the walls too thin, and so long as the doors, window-frames, &c., are constructed of unseasoned wood, manipulated by trades-unionist carpenters, so long we shall be compelled to consume more fuel than would be otherwise necessary. If ever the day comes when master and man drop the modern principle of working as badly as they dare, other improvements will follow.

Lectures on Domestic Hygiene and Home Nursing. By LIONEL A. WEATHERLEY, M.D. London: Griffith and Farran.

THIS useful little work scarcely falls within our jurisdiction. The author gives a catalogue of some disinfectants in general use, and speaks well of all. He remarks that chloralum is not volatile, and cannot be used as an aërial disinfectant—statements which hold equally good concerning "Condy's Fluid." Who, by the way, is "Professor Franklyn," cited as recommending chloralum? We are not acquainted with any chemist of that name—a name which seems to require dissociation. The remark that disinfectants stand distinctly second to efficient ventilation is very just. Indeed, aërial disinfection is scarcely possible in an inhabited room. It is but too probable that long before all morbific matter, organised or otherwise, could be destroyed the human inmates would succumb.

We are glad to see that Dr. Weatherley puts in a timely word of caution against that deplorable mania of the day which would place the nurse on a level with or above the physician.

Memoirs of the Science Department University of Tokio, Japan, (Vol. II.) *on Mining and Mines in Japan.* By C. NETTO, M.E., Professor of Mining and Metallurgy, University of Tokio. Published by the University.

IT appears that when Japan was first thrown open to the commerce of the world, very exaggerated notions prevailed concerning its mineral wealth, especially as regards gold and copper. It has since been found that these ideas were ill-founded. The richest and most available deposits of both metals have long since been extracted, and though mining may still be carried on to advantage, ample capital and considerable patience will be required. The useful minerals now raised in Japan rank thus in the order of their importance: Coal, copper, silver, gold, iron, kaolin, petroleum, sulphur, lead, antimony, tin, cobalt, mercury, marble, jasper, agate, amber, and graphite. Nickel, zinc, and arsenic have not been found in sufficient quantities for industrial purposes. Coal is now exported to the extent of 160,000,000 catties (1 catty = 1⅓ lb. avoirdupois), but 47,396,160 catties are still imported. It is much to be deplored that charcoal-burning is carried on in a reckless and wasteful manner, and that the mountains are consequently becoming denuded, to the ultimate injury of the climate and of the productiveness of the soil. The exports include sulphur 1½ million catties and sulphuric acid 1,400,000 catties.

The author gives a description of the mining processes now in use, with figures of the mining, dressing, and metallurgical tools.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin.

No. 5, 1880.

On Digallic Acid..—Hugo Schiff.—A reply to P. Freda. (See *Berichte*, xii., p. 33.)

On Oxypropionic (Oxyacrylic Acid).—E. Erlenmeyer.—Not adapted for useful abstraction.

Di-iodopropylic Alcohol and a Mono-iodoallylic Alcohol.—H. Hübner and E. Lellmann.—The former of these compounds forms long colourless needles, easily affected by light and heat, soluble in water, insoluble in alcohol, and having the composition $C_3H_5I_2OH$. If the solution of this compound is heated in chloroform, the result is C_3H_4IOH, which crystallises in delicate needles, melting at 160° F.

Nitration of Paranitrobenzoic Acid to form a Dinitrobenzoic Acid.—H. Hübner and A. Stromeyer.—The authors have formed and examined dinitrobenzoic acid, and its barium, calcium, and magnesium salts, and have obtained a nitroamidic acid and certain derivatives, with the examination of which they are still engaged.

A new Synthesis of Phosphenyl Sulpho-Chloride.—H. Koehler.—Twenty parts phosphenyl-chloride were placed in a small flask with a reflux condenser, and five parts sulphur chloride were slowly added by means of a dropping-funnel. After the reaction is over, the flask is set in a freezing mixture of Glauber's salt and hydrochloric acid. Pale yellow crystals of phosphenyl-tetrachloride are formed, from which the liquid is separated by decantation, then shaken with water, dried, and rectified. The yield is almost quantitive.

Ortho-chlor-benz-paratoluide and its Derivatives.—H. Schreib.—The derivatives described are ortho-chlor-benz-meta-nitro-para-toluide, dinitro-ortho-chlor-benz-para-toluide, trinitro-ortho-chlor-benz-para-toluide, ortho-chlor-benz-amido-para-toluide, benzoylised ortho-chlor-benz-metamido-para-toluide, and anhydro-ortho-chlor-benz-metamido-para-toluide.

On the Relation of Molecular Weight and Density in the Gaseous State.—Alex. Naumann.—The author points out certain errors in a paper by Gustave Schmidt on the relative volumes of gases.—*Ann. Physik*, 1879, vi., 612.

Some Derivatives of Xylol.—R. Netzki.—An investigation of amidoazoxylol, para-xylendiamine, xyloquinone, and hydro-xyloquinone.

Action of Finely Divided Silver upon Monobrombutyric-ethyl-ester.—Carl Hell and O. Mühlhäuser.—The action of silver upon monobrombutyric-ethy-lester is the similar to that upon the monobrom-substitution product of isobutyric ethpl-ester. The great number of products, the trifling yield of diethylsuccinic-ester, and the appearance of several of its isomers show that the reaction of silver with the brom-ester of a fatty acid is not very smooth, and does not consist in the mere elimination of the atoms of halogens.

On the Acids $C_8H_{14}O_4$ formed from Butyric Acid.—Carl Hell and O. Mühlhäuser.—Besides a volatile oily acid, probably identical with isocrotonic acid, there are formed by the reaction of siver and bromobutyric acid, two acids agreeing in composition with suberic acid, but distinctly different from each other, and from the two isomeric acids produced by a corresponding reaction with brom-isobutyric acid. There exist, therefore, five isomeric suberic acids.

More Particular Observations on the Action of Potassium Carbonate upon Isobutyl-aldehyd.—F. Urech.—The author placed about 3 grms. pure isobutyl-aldehyd in a narrow test-tube graduated in half millimetres. With a lens it was possible to read accurately quarter millimetres. After 3 decigrms. of finely-powered recently-ignited potassium carbonate had been added, the tube was closed, set in a horizontal position, and the level read off every five minutes for forty-eight hours. The liquid was found to have sunk from 21·50 to 14·50 degrees.

Further Notes on the Reaction of Potassium Cyanide and Sulpho-cyanide, Acetone, and Aqueous Hydrochloric Acid.—F. Urech.—The author names the compound produced acetonyl-sulpho-carbaminate. By acetonyl he understands the radicle of acetonic acid.

On Ballo's supposed Adipic Acid obtained from Camphor.—J. Kachler.—On oxidation with chromic acid camphor does not yield adipic acid, but the same oxidation-products as with nitric acid. Chromic acid, however, converts the camphoric acid first formed completely into members poorer in carbon.

Action of Iodethyl upon Iodacetic-ethyl-ester—L. Aronstein and J. M. A. Kramps.—The authors exposed molecular proportions of the above-mentioned substances to a temperature of 230° for several hours in a sealed tube. The chief result was ethylen iodide, along with acetic acid and unchanged ethyl iodide. No trace of butyric acid or butyric ethyl-ester was perceptible.

On γ-Sulpho-isophthalic Acid and the corresponding γ-Oxy-isophthalic Acid.—Karl Heine.—Not susceptible of useful abstraction.

The Formation-heat of Ammonia, of the Oxides and Acids of Nitrogen, and of the Nitrates.—Julius Thomsen.—The formation-heat of ammonia is 11,890 cal. The author gives tables of the formation-heat of nitrous and nitric oxide, nitrous acid, nitrogen dinoxide, nitric acid, and of the anhydrous nitrates. These tables the author wishes to be taken in place of *Berichte* tables 1 and 2 in his Memoir (xii., p. 2064).

On the Remarkable Reducing Properties of Potassium Ferrous Oxalate, and on some of the Reactions thus Produced.—J. M. Eder.—Ferrous oxalate is very permanent on exposure to the air, both in a wet and a dry state, and possesses very feeble reducing properties. The solution of ferrous oxalate in potassium oxalate, as well as the solid double salt, takes up oxygen greedily, and passes into potassium ferric oxalate. Its affinity for oxygen is equal to that of an alkaline ferrous hydrate, or of ammoniacal cuprous chloride, or of pyrogallic acid in an alkaline solution. The double oxalate exerts its reducing powers not merely in alkaline, but in neutral, and even acid solutions. The solution quickly reduces platinum chloride and silver nitrate to metal. Silver chloride, bromide, and iodide are reduced completely, but more slowly. Copper acetate is reduced very slowly to cuprous oxide, and even to metal. With the aid of heat mercuric chloride is reduced to metal. Recently precipitated Prussian blue is reduced to white ferro-cyan iron potassium. Indigo blue is reduced to white indigo, and solutions of sulphindigotic acid are rapidly decolourised.

A New Method for the Quantitative Determination of Ferrous Oxide in Presence of Organic Acids and of Cane-sugar.—J. M. Eder.—Already noticed.

Action of Alcohols and Phenols upon the Imid Chlorides of Acids.—O. Wallach and A. Liebmann.—Not adapted for useful abstraction.

On Oxal-ethyline and Chloroxal-allyline.—O. Wallach and G. Stricker.—A description of these compounds and of their more characteristic derivatives.

On Bases of the Oxalic Acid Series.—O. Wallach and Ernst Schulze.—The bases examined are chloroxal-ethyline, oxal-ethyline, chloroxal-propyline, and chlor-oxal-amyline.

Formation of Bases from Substituted Acid Amides.—O. Wallach and Iwan Kamenski.—The authors conclude that if a base is formed by the action of phosphorus pentachloride from a substituted amide of monobasic acids with a short carbon chain, two molecules of the amide enter into reaction in such a manner that hydrogen is derived from the hydrocarbon radicle pertaining to the acid, in order to form hydrochloric acid.

Remarks on the Previous Memoirs.—O. Wallach.—Not susceptible of useful abstraction.

Transformation of Azoxybenzol into Oxyazobenzol.—O. Wallach and L. Belli.—An isomer of azoxybenzol was obtained by treatment with sulphuric acid and dilution with water, when the new compound was obtained in the form of small garnet-red crystals.

Further Contributions to the Knowledge of the Thiamides.—O. Wallach.—A notice of methyl-iso-thiacetanilide, thiacet-methylanilde, thiacet-orthotoluidide, and thiacet-paratoluidide.

Velocity of the Substitution of Bromine in the Fatty Acid Series.—Carl Hell and Fr. Urech.—The authors give tables showing the progress of the reaction of bromine with the acetic and propionic acids, normal butyric and isobutyric acids, the valerianic, capronic, and caprylic acids. They recognise three successive stages: that of slow action, from the beginning of the application of heat till 10 to 20 per cent of the molecules of bromine present have entered into reaction, the stage of acceleration, which lasts until about 60 per cent of the bromine has acted, and the final stage of retardation, which lasts till the process is complete. The effect of the molecular magnitude appears in the first stage. In acetic acid 15 per cent of the bromine molecules present are substituted in 40 hours; in the next homologous acid this proportion is reached in 10 hours, in normal butyric acid in 7, and in isobutyric acid in 2.

New Colouring Matters.—W. V. Miller.—An examination of the colour known under the trade-name "Biebrich Scarlet." It appeared to be formed by diazotising so-called "acid yellow," and combining it with β-naphthol.

Homofluoresceine: a New Colouring Matter from Orcine and its Derivatives.—H. Schwarz.—On heating solutions of oreine with caustic alkalies and chloroform the liquid becomes purple and then fiery red, and on dilution shows a strong greenish-yellow fluorescence. This action is exceedingly sensitive. On neutralising and adding bromine-water a compound is formed from the fluorescent colouring matter resembling eosine; its alkaline alcoholic solutions appear cherry-red by transmitted light with yellow fluorescence. The author describes homo-fluoresceine, its salts and derivatives. Though many of these compounds have splendid colours, only the nitro-derivatives are suitable for dyeing. Hexa-nitro-mono-oxy-homo-fluoresceine dyes silk a brilliant orange, the penta-nitro-diazo-amido-monoxy-homo-fluoresceine compounds a gold yellow and cyamic acid a light reddish-yellow.

Chemisches Central-blatt.

No. 26, 1880.

Coarse and Fine Superphosphates.—Fr. Farsky.—Finely granular superphosphate contains less soluble phosphoric acid than the coarse, and is less liable to reversion. For plants which stand close together, fine superphosphates are preferable to coarse sorts for such as are set at considerable distances.—*Listy Chem.*, 4, 161.

No. 27, 1880.

Density of Liquid Oxygen.—J. Offret.—The author has revised Pictet's calculation of the density of liquefied oxygen and considers the method inadmissible. His own calculation gives 0·840.

Explosive Antimony.—E. Mascarenas y Hernandez.—A solution of crystalline antimony chloride and hydrochloric acid at 1·12 sp. gr. was prepared so as to stand at 38° B. On electrolysis with the Lechlanché element there was obtained in twenty to twenty four hours a most explosive deposit.

Antimonial Cinnabar.—N. Teck.—The author prepared this compound by two methods. A solution of four parts tartar emetic and three parts tartaric acid in eighteen parts water at 60° was mixed with a solution of sodium hyposulphite and heated to about 90° (Wagner). Again, 4 vols. of antimony chloride of sp. gr. 1·19 were mixed with 10 vols. water and 10 vols. of a solution of sodium hyposulphite at 1·19 sp. gr., and heated very gradually to 55° (Mathieu Plessy). In each case the precipitate was well washed and dried. Antimonial cinnabar consists of homogeneous granules, in which no crystalline structure is perceptible.

A Colouring Matter from Carbon Disulphide.—C. Reichl.—If carbon disulphide is agitated with semi-fluid sodium amalgam, and if the paste-like mass is mixed with water, there is produced a hyacinth-red liquid, whilst mercury and mercury sulphide are deposited. The solution contains the sodium salt of a yet unknown acid, somewhat soluble in hot water, and more readily in alcohol. It dyes yellow, orange, and brown shades on wool and silk.—*Polyt. Notizblatt*, 35, 151.

Action of Oxalic Acid and Sulphuric Acid upon Naphthol.—M. Honig.—From α naphthol the author obtains a body which he names naphthanthraquinon. He is engaged with the further examination of this compound and of its derivatives.

Detection of Albumen in Urine.—H. Boedecker.—The urine is slightly acidulated with acetic acid, a few drops of potassium ferrocyanide are added, and a gentle heat is applied. If albumen is present, a turbidity appears followed by a flocculent precipitate.

Detection of pre-formed Urobiline in Urine.—E. Salkowski.—One hundred c.c. of urine are gently shaken up with 50 c.c. of perfectly pure ether; the ether decanted off and evaporated. The residue is taken up in absolute alcohol, and is rose-coloured with a green fluorescence. The experiment does not always succeed.

On the Crysalline Constituents of Corallin.—Carl Zulkowski.—This paper will, if possible, be inserted at length.

No. 28, 1880.

This number is devoted to an account of apparatus, scientific and industrial. None of the descriptions are capable of reproduction, as they would be unintelligible without the accompanying wood-cuts.

MISCELLANEOUS.

Royal Polytechnic Institution.—On Monday, December 27th, the Christmas entertainment commenced at this Institution. The programme is varied and entertaining. In his lecture on "Scientific Wonders," Mr. J. L. King described very fully the Photophone, and his description was made easier to understand by some very good illustrations. He then went on to explain and show several more interesting phenomena, such as Balmain's luminous paint, the lighting power of which is increased very considerably by treating with hot water. The affinity of different elements for each other was then pointed out and proved by experiments, of which the ignition of finely divided lead when placed in contact with the air may be taken as an example. Other experiments illustrating other chemical changes were shown, and much stress was laid on the change of colour of two solutions when added one to the other. In the Great Hall, some very pretty effects were produced by throwing the image of chromatic magic lantern slides on to a spray fountain. The entertainment altogether is interesting, as science and amusement are so well combined.

Society of Arts.—The dates for some of the papers which will be read at the Society of Arts before Easter next have been announced. The following are set down for the ordinary meetings (Wednesday evenings):—January 12.—"A Sanitary Protection Association for London," by W. Fleeming Jenkin, F.R.S. (On this evening Professor Huxley will preside.) January 19.—"Causes of Success and Failure in Modern Gold-mining," by A. G. Lock. January 26.—"Five Years' Experience of the Working of the Trade Marks' Registration Act," by Edmund Johnson. February 2.—"Trade Prospects," by Stephen Bourne. February 9.—"The Present Condition of the Art of Wood-carving in England," by J. Hungerford Pollon. February 16.—"The Participation of Labour in the Profits of Enterprise," by Sedley Taylor, M.A., late Fellow of Trinity College, Cambridge. February 23.—"Recent Advances in Electric Lighting," by W. H. Preece, Pres. Soc. Tel. Eng. March 2.—"Flashing Signals for Lighthouses," by Sir William Thomson, F.R.S. March 9.—"Improvements in the Treatment of Esparto for the Manufacture of Paper," by William Arnot, F.C.S. March 16.—"The Manufacture of Aerated Waters," by T. P. Bruce Warren. In the Indian Section (Friday evenings) the following will be read:—January 21.—"Forest Conservancy in India," by Sir Richard Temple, Bart., G.C.S.I. February 11.—"The Gold-fields of India," by Hyde Clarke. March 4.—"The Results of British Rule in India," by J. M. Maclean. March 25.—"The Tenure and Cultivation of Land in India," by Sir George Campbell, K.C.S.I., M.P. The dates and papers for the Foreign and Colonial Section (Tuesday evenings) will be:—February 1.—"The Industrial Products of South Africa," by the Right Hon. Sir Henry Bartle Edward Frere, Bart., G.C.B., G.C.S.I., D.C.L., LL.D., F.R.G.S., &c. February 22.—"The Languages of South Africa," by Robert Cust. March 15.—"The Loo Choo Islands," by Consul John A. Gubbins. April 5.—"Trade Relations between Great Britain and her Dependencies," by William Westgarth. For the Applied Chemistry and Physics Section (Thursday evenings), the arrangements are as follows:—January 27.—"A New Mechanical Furnace, and a Continuous System of Manufacturing Sulphate of Soda," by James Mactear. February 24.—"Deep Sea Investigation, and the Apparatus used in it," by J. G. Buchanan, F.R.S.E., F.C.S. March 24.—"The Future Development of Electrical Appliances," by Prof. John Perry.

MEETINGS FOR THE WEEK.

Monday, 10th.—London Institution, 5.
—— Medical, 8.30.
Tuesday, 11th.—Civil Engineers, 8.
—— Medical and Chirurgical, 8.30.
Wednesday, 12th.—Society of Arts, 8.
—— Microscopical, 8.
Thursday, 13th.—London Institution, 7.
—— Royal, 4.30.
—— Royal Society Club, 6.30.
—— Mathematical, 8.
Friday, 14th.—Astronomical, 8.
—— Quekett, 8.

THE CHEMICAL NEWS
AND
JOURNAL OF PHYSICAL SCIENCE.

Edited by WILLIAM CROOKES, F.R.S.

Published every Friday. Price 4d. Annual Subscription, post free including Indices, £1

CHARGES FOR ADVERTISEMENTS.

	£	s.	d.
Five lines in column (about 10 words to line)	0	3	6
Each additional line	0	0	6
Whole column	1	15	0
Whole page	3	0	0

A reduction made for a series of insertions.

Cheques and Post-Office Orders, crossed "London and County Bank," payable to the order of William Crookes.

BOY COURT, LUDGATE HILL LONDON, E.C.

MR. J. S. MERRY,
ASSAYER AND ANALYTICAL CHEMIST,
SWANSEA.

BISULPHITE OF LIME.
BISULPHITE OF SODA.
SULPHITE OF SODA. TANNATE OF SODA.

WILLIAM MARRIOTT
CHEMICAL WORKS, HUDDERSFIELD

MOTTERSHEAD & CO.,
7, Exchange Street and 10, Half Moon Street,
MANCHESTER.

CHEMICAL & PHYSICAL APPARATUS,
BOTTLES, PURE CHEMICALS,
REAGENTS, STANDARD SOLUTIONS,
And Every Requirement for Works' or School Laboratories or Private Students.

Illustrated Price Lists on application.

Water-Glass, or Soluble Silicates of Soda and Potash, in large or small quantities, and either solid or in solution, at ROBERT RUMNEY'S Ardwick Chemical Works, Manchester.

Wanted, to Purchase Volumes 1, 3, 5, 6, and 7, of the "Journal of the Chemical Society"; also Vol. 3 of the "Proceedings of the Royal Society."—Address, K. P. G., Chemical News Office, Boy Court, Ludgate Hill, London, E.C.

ROYAL POLYTECHNIC.—Utopia, a Grand Fairy romance. The Electrical Railway; Great Lightning Inductorium; a Lecture on Scientific Wonders, by Mr. J. L. King. Musical Sketches, by Mr. Eric Lewis. Christmas and its Customs, by Mr. Frank Heath. Humorous Recitals, by Madame Hickson. Blondin, Leotard, Diving Bell, &c. Admission to the whole, 1s. Open from 11 till 5, and from 6 till 10.

CITY AND GUILDS OF LONDON INSTITUTE FOR THE ADVANCEMENT OF TECHNICAL EDUCATION.

SPRING COURSES OF
LECTURES AND LABORATORY INSTRUCTION
At the Temporary Class-Rooms of the Institute,
COWPER STREET, FINSBURY,
Commencing January 24th, 1881.

CHEMICAL TECHNOLOGY—Professor ARMSTRONG, Ph.D., F.R.S.

Evening Courses—
Coal-Tar Products—Mondays.
Photography—Wednesdays.

Day Courses—
Coal-Gas and its Uses as an Illuminating and Heating Agent—Fridays.
Junior Chemistry—Introduction to Theory and Practice—Tuesdays and Thursdays.

PHYSICAL TECHNOLOGY—Professor AYRTON, A.M. Inst. C.E.

Evening Courses—
Electrical Instrument Making—Tuesdays.
The Electric Light—Fridays.

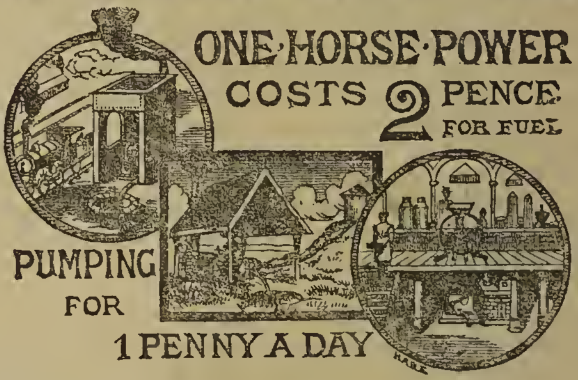
Day Courses—
Motor Machinery—Mondays.
Junior Electricity and Magnetism—Wednesdays and Thursdays.

Fees for Lectures and Laboratory Course together—5s. and 7s. 6d.

Laboratory open Daily from 10 to 1 and from 2 to 5.

Detailed Prospectus to be had on application to the Professors at Cowper Street; or to—
PHILIP MAGNUS, Director and Secretary.
Gresham College, E.C., January, 1881.

BAILEY'S PATENT HOT-AIR ENGINE.



Made from ½ to 5 horse-power. 56lbs. of coke will keep a 1-horse going 12 hours. 1000 galls. of water lifted 50 feet high for a penny.

NO BOILER. NO DANGER.

Awarded Prize Medal by the chief Societies.

SOLE MAKERS—
W. H. BAILEY & Co., Albion Works, Salford, Manchester

ASBESTOS.

H. W. JOHN'S MANUFACTURING CO. have appointed WITTY and WYATT Sole European and Colonial Agents for their well known ASBESTOS Fire-proof Paints and other materials, which for twenty years have been largely used in the United States, South America, China, Japan, &c.

ASBESTOS RETORT CEMENT is Fire- and Acid-Proof; when subjected to intense heat will vitrify without shrinking, thus rendering it of great value in repairing retorts, pipes, and other chemical appliances.

WITTY AND WYATT, 9, Fenchurch Street, E.C.
ASBESTOS WAREHOUSES, 1, Fenchurch Avenue.

SOUTH LONDON SCHOOL OF PHARMACY.

Special advantages are offered to Private Students during the Vacation in every branch of Practical Chemistry, as applied to Manufactures, Agricultural and Commercial Products, Water, Gas, Food, &c.

For terms, personal or by letter [illegible] Baxte[illegible] Secretary, Central Public Laboratory, Kennington Cr[illegible] E.

THE CHEMICAL NEWS.

VOL. XLIII. No. 1103.

ON THE HISTORY OF THE PERIODIC LAW.

By D. MENDELEJEFF.

As a reply to the claims of H. Lothar Meyer (*Berichte*, xiii., 259) respecting the discovery and development of the periodic law, I send, for the library of the German Chemical Society, two numbers of the *Journal of the Russian Chemical Society* containing my first printed original memoirs relating to the periodic law. Both appeared in 1869, and contain—1st, on pp. 60 to 77, my treatise read March 6/18, 1869, at a meeting of the Russian Chemical Society, and entitled "On the Relations of the Properties to the Atomic Weights of the Elements"; 2nd, on pp. 229, 230, a Report of the Second Congress of Russian Naturalists at Moscow, August 23, 1869, when I read a communication on the "Atomic Volume of the Elements." Both these memoirs appeared earlier than the treatise of H. L. Meyer (*Ann. Chem. Pharm.*, 1870, Supplement, vol. vii.), dated December, 1869, from which, according to him, I have "accepted as correct nearly everything which I (L. Meyer) had added to his (Mendelejeff's) researches," (*Berichte*, xiii., 263), and have "utilised facts without mentioning me (L. Meyer)."

From a translation of certain passages of my memoirs of March and August, 1869, which I here append, the inaccuracy of H. Lothar Meyer's contention will appear, the rather as he quotes an abstract from the *Zeitschrift f. Chemie*, 1869, p. 406, and the editor of that journal refers in this abstract to the original source, *i. e.*, to my memoir p. 60; hence the latter might have been known to H. L. Meyer.

The author here makes extensive quotations from his memoirs above mentioned, and resumes :—From these extracts it appears that, 1st, I had in March and August, 1869, expressed all the ideas which up to the present day represent the foundation of the periodic law; 2nd, that before me H. L. Meyer had not the periodic law in mind, and has added nothing new to it after me; 3rd, that H. L. Meyer, in advance of all other German chemists, was the first to comprehend the external side of the ideas concerning the periodic law; 4th, but had not penetrated the inner meaning of the periodic system after the appearance (1869) of my first memoirs, for in his paper, published in 1870 in the *Ann. Chem. Pharm.*, he repeats in a modified form what I had uttered before him, and left those phases of the subject (composition of the oxides, prediction of the properties of unknown elements, alteration of the atomic weights of Ce, Yt, Ur, &c.) which alone can serve to establish the correctness and universality of the law, undeveloped. These phases had to be explained by myself in the years 1870 to 1875, though they had been preliminarily touched upon in my first treatise (March, 1869). If anything new has been contributed to the development of the doctrine of the periodic law, it is due to Mr. Th. Carnelley, who has shown (*Berichte*, xii., 440; *Phil. Mag.*, Oct., Nov., Dec., 1879) that the melting-points and magnetic properties are periodically connected with the atomic weights.

I think I ought to mention that English journals (*e.g.*, *Phil. Mag.*, Oct., 1869, p. 310) maintain that Mr. Newlands (CHEMICAL NEWS, x., 59, 154, and xiii., 113) prior to me announced a law similar to the periodic, in 1864. I have hitherto not been able to obtain this volume of the CHEMICAL NEWS. Supposing, however, that our fundamental ideas were absolutely identical, and that the "investigation" for which H. L. Meyer is preparing (*Berichte*, xii., p. 261) turns out successful in this respect, I must point to the well-known examples that Kirchhoff and R. Meyer had prior to Lavoisier* expressed the ideas which nevertheless served as the foundation of the fame of this *savant*. That person is rightly regarded as the creator of a scientific idea who perceives not merely its philosophical, but its real aspect, and who understands so to illustrate the matter that everyone can become convinced of its truth. Then alone the idea, like matter, becomes indestructible. It is possible that Newlands has prior to me enunciated something similar to the periodic law, but even this cannot be said of H. L. Meyer. The present position of the question of elemental periodicity is not in the least indebted either to Mr. Newlands or H. L. Meyer.—*Berichte der Deutsch. Chem. Gesellschaft*, xiii., p. 1796.

THE HISTORY OF ATOMIC PERIODICITY.

By LOTHAR MEYER.

CONTRARY to my expectation, my note, printed on p. 257 of the *Berichte*, and as I believe very impersonal in its character, has drawn forth a violent reply from H. D. Mendelejeff. In order not to extend these lengthy explanations any further, I make merely the following remarks :—

What I wrote in December 1869, concerning the periodicity of properties I had found before the abstract of H. Mendelejeff's researches, published in the same year in the *Zeitschrift für Chemie*, fell into my hands. I claimed for myself, of course, merely matter which this abstract did not contain, or which in it seemed to require amendment. H. Mendelejeff now alleges that his memoirs, then published in the Russian language, contained all my additions and amendments, and blames me for not having procured the original documents. It seems to me too strong a demand that we German chemists should read, not merely the memoirs appearing in the Germanic and Romanic languages, but those also which are produced in the Slavic tongues and should test the German abstracts as to their accuracy.

H. Mendelejeff further considers my claim that, in his memoir published in *Liebig's Annalen*, 1871, he should have noticed my paper which appeared in 1870 in the same journal as quite unnecessary. I adhere to my view that he ought to have noticed it, even if not containing as much as he, according to his present statement, had recognised as valuable in an earlier Russian publication. He might thus have avoided the appearance of overlooking it intentionally and have saved us both the trouble of these explanations. Into the latter, I for my part would not have entered had I not been induced by the letter of M. Wurtz printed on p. 6 of the present volume of the *Berichte*. The accusation that I have not made sufficient reference to him could scarcely be brought in earnest by H. Mendelejeff (*Berichte*, xiii., p. 1798). No one probably has taken such pains to secure for the results of H. Mendelejeff's researches universal diffusion and recognition as I have done in the three editions of my "Modern Theories of Chemistry," which have since appeared.—*Berichte der Deutsch. Chem. Gesellschaft*, xiii., p. 2043.

PROF. WURTZ ON THE PERIODIC CLASSIFICATION OF MENDELEJEFF.†

HAVING given an exposition of this important and interesting arrangement of the elements from the pen of its author, and being about to notice the controversy now going on between Professors Mendelejeff and Lothar

---

* *Sic* in original.

† See "Wurtz on the Atomic Theory." London: C. Kegan Paul and Co.

Meyer, it becomes our duty to lay before our readers a brief summary of the criticism of Prof. Wurtz upon the periodic classification.

He remarks that the proposition of the great Russian chemist is not limited to any particular group of elements, but embraces all the elementary bodies. It is not confined to a consideration of certain analogies, but comprises all physical and chemical properties. It is a powerful generalisation, and must in future be taken into account whenever we regard the facts of chemistry from a lofty and comprehensive point of view. The attempt, however, still presents many imperfections, greatly due to the uncertain state of our present knowledge, especially as regards rare elements. Thus tellurium is not in its true place supposing its atomic weight to have been correctly determined. If it were the intermediate member between antimony and iodine it should have an atomic weight of about 125. It may also be asked whether copper is rightly placed, separated as it is from certain elements, *e.g.*, mercury, which it seems to resemble. Other bodies, such as cobalt and nickel, whose atomic weights are very similar if not identical, also give rise to a difficulty. According to the principle of the periodic classification their properties should also coincide, which is not the case, although they have many points in common. This also holds good with chrome, manganese, and iron, which are placed side by side in the same horizontal series, and between whose atomic weights there is very slight difference. On the other hand, there are wide differences between the properties of vanadium and bromine, between potassium and calcium, between rubidium and ruthenium, which are yet so closely related as to their atomic weight. It must further be admitted that the gradations of properties are far from progressing regularly or uniformly in the different groups. Sometimes they are too great, as in the first group, carbon, nitrogen, oxygen, and fluorine, and sometimes too small, as we have just remarked for the last terms of the third group. Though it may be generally true that the properties of bodies are subject to periodic modifications with the increase of their atomic weights, the law of these modifications escapes our observation, and seems to be of a compound nature; for, on the one hand, the atomic weights of successive elements vary within considerable limits without displaying any regularity in these variations; on the other hand, the gradations of properties—or, in other words, the greater or less divergencies between the properties of successive elements, do not appear to depend upon the degree of the differences between the atomic weights. In Mendelejeff's table we are chiefly struck with the gaps between two elements, the atomic weights of which show a greater difference than two or three units, thus marking an interruption in the progression of the atomic weights. Between zinc (64·9) and arsenic (74·9) there were two, one of which has been lately filled up by the discovery of gallium. But the considerations by which Lecoq de Boisbaudran was led in the search for gallium have nothing in common with the conception of Mendelejeff. Though gallium has filled up a gap between zinc and arsenic, and though other intervals may be filled up in future, it does not follow that the atomic weights of such new elements will be those assigned to them by this principle of classification. The atomic weight of gallium is sensibly different from that predicted by Mendelejeff. It is also possible that the future may have in reserve for us the discovery of a new element whose atomic weight will closely coincide with that of a known element, as do the atomic weights of nickel and cobalt. Such a discovery would not fill any foreseen gap. If cobalt were unknown it would not be discovered in consequence of Mendelejeff's classification.

Prof. Wurtz considers that Lothar Meyer has contributed a detailed and important development to Mendelejeff's ideas, showing that the physical properties of the elements are subject to periodic variations with the increasing value of their atomic weights. These facts as regards malleability, fusibility, volatility, and conductility for heat and electricity, Prof. Meyer has embodied in a graphic construction which appears at the end of M. Wurtz's work on the "Atomic Theory." In connection with this subject may be mentioned a relation pointed out by M. Lecoq de Boisbaudran between the atomic weights of bodies and their power of emitting luminous rays. He proves that for analogous bodies, such as potassium, rubidium, and cæsium; calcium, strontium, and barium; aluminium, gallium, and indium, the increase of atomic weight is proportional to the wave-length corresponding with the spectral lines of each metal. This idea led the way to the discovery of gallium, and it was even possible to calculate the atomic weight of this metal with those of aluminium and indium from the position of the corresponding spectral lines of the three metals.

VARIOLA, VACCINE, AND CHICKEN CHOLERA

By L. PASTEUR.

The following paper was read before the Academy of Medicine of Paris (meeting of June 1st) in answer to Drs. Guérin, Blot, and Depaul[*]:—

That variola and vaccine are deeply interesting to this Academy is what may be expected, as the discovery of vaccine is one of the greatest triumphs of medical science. I recollect the noble words of William Pitt, when urging before Parliament the bill to confer a national reward on Jenner.

"The House need have no fear that the reward shall be too great for the service rendered, for this cannot be exceeded. You may vote anything you please to the discoverer of vaccine, and you may be sure of universal approbation."

I need to refer to these great memories and to the feeling of respect due to this great discovery to understand, but not to justify, the emotion which, at the last meeting, overcame the minds of MM. Jules Guérin, Blot, and Depaul. I merely made a remark on the relations of the virus of variola to that of vaccine. I said that medical science was divided on the subject of the dependence or independence of these two viruses, and forthwith a tempest was raised. Messrs. Jules Guérin and Blot accused me of ignorance. M. Guérin referred me to the discussions which took place in this Academy in 1863 and 1864. M. Blot begged of me to go to the library to read these discussions, and that light would dawn on my mind. M. Depaul made me observe that I am not authorised to speak of medicine by my previous studies, and he illustrated his meaning by the following observations, which I ask leave of the Academy to reproduce:

"And it is when medical science is placed on such solid foundations that M. Pasteur expects to upset everything by a few laboratory experiments! I have nothing to say about the cultivation of germs; I am willing to accept everything—declaring, however, that I am not competent to speak about what happens in retorts.[†] But when M. Pasteur drops the part of the skilful experimenter, and undertakes to make applications to medicine, I beg leave to differ from him. For instance, in his recent communication on chicken cholera, in which the discovery of a new germ has opened such vast prospects to his mind, I find that he draws conclusions that are not in accordance with his premises. How can he prove that these infinitely small organisms are the true cause of chicken cholera? Could it not be maintained with equal probability that they are the results of the disease. We have been told that chickens inoculated with the liquid of cultivation had died of chicken cholera, but our eminent colleague has forgotten to prove it. Only one fact is beyond doubt; it

---

[*] From *Moniteur Scientifique Quesneville* for July, 1880, p. 782. By P. Casamajor.

[†] Can Dr. Depaul speak more knowingly of what happens in the human body?—*Trans.*

is that the chickens have died; as to the symptoms, I do not find that they are the same as those of the spontaneous disease. They have died poisoned. This is about all that can be said, if we wish to avoid entering the domain of hypotheses and of preconceived ideas."

That I am ignorant of medical and veterinary matters I admit, for I have often avowed it in this very place. I repeat this confession before you now, but I will say that when an accusation of this nature is made by members of this Academy it becomes a very grave matter, for it means that I speak of things of which I am ignorant, and that I am meddling with medical science without authority. In these conditions my pride as a conscientious investigator rebels against such imputations, and here is my answer:

I owe to myself this justice to say that I never rose among you to speak but it was to enlighten you. The humblest of schoolboys is a master before a scientific assembly when he brings new facts and new ideas. I also owe it to myself to say that I have never intruded on the domain of medicine without extending its boundaries.

As to the question that I have raised, I maintain that I am in the right, that there ought to be controversies on the relations of variola to vaccine, and that what I have observed in chicken cholera leads to the inquiry, whether variola virus can be converted into vaccine virus without passing through the body of animals. Have I not here before me partisans of the dependence, as well as of the independence, of the two viruses. I am waiting for proofs of my being mistaken when I assert that in medical science there are now on this subject two contradictory opinions. I await these, and I wish to discuss this subject to show you that I am far from having spoken on a subject of which I was ignorant, and the blame is with yourselves, who, having no knowledge of it and not understanding it fully, have been led to accuse me of incompetence.

I now come to the example of M. Depaul, to chicken cholera, to the *cultivation of germs in retorts*, according to the expression of M. Depaul. I wish to ask whether I have really *forgotten to prove* that the microscopical germ of chicken cholera is the only cause of disease and death. Here is a vessel containing chicken broth in a state of purity, by which I mean that it will remain in its present condition, without any change, if placed in contact with air perfectly free from any germ of fermentation. The limpidity of the liquid is perfect. On the other hand, we have here two vessels containing turbid liquid. They both contain cultivations of the germ of chicken cholera. This one, at 1 o'clock yesterday afternoon, was in the same state of limpidity as the liquid in the first vessel which I have shown you. To bring the liquid to its present condition I have used this small flask, containing a minute quantity of a liquid of a previous cultivation, and a glass rod drawn to a very fine point. This rod is not hollow, and the only portion of liquid which the fine point can take up is what adheres to its surface. I have transferred this quantity to the clear liquid, and the microscopic organism, although introduced in such infinitely small quanitity, has multiplied so rapidly that a few hours afterwards silky waves could be seen in the liquid, formed by clouds of germs; and, after 24 hours, the turbidity is as you see it. This liquid, which yesterday was nothing but nutritious chicken broth, so perfectly inoffensive that you could inject 1, 2, 10, 20 cubic centimetres under the skin of a chicken without causing either disease or death, is, at this moment, so virulent that if you inject the smallest fraction of a drop under the skin, the chicken will die; its own body will become virulent after local disorders, exhibits of which I place here before you that you may judge of their truly extraordinary and frightful nature.

Do you want now the proof that in this liquid only the solid and animated portion can give rise to the disease? The proof is this:

Filter this liquid by means of this apparatus, which will retain even the smallest of these germs, and inject this filtered liquid under the skin, in quantities equal to tens of cubic centimetres, and no more harm will result than from the injection of the broth before any propagation of germ had taken place in it.

M. Depaul, are you satisfied?

Perhaps not yet. This filtration probably disturbs you. This is too much chemistry, too much *retorts*, as you express it. Then take this tube, full of germs, suspend it for a few days in a place where the temperature is constant, and the germs will fall to the bottom. If we inoculate two chickens, one with the clear liquid at the top, and the other with the liquid of the lower stratum, the first chicken will remain in good health, and the second will die.

You may talk of poison, if you choose; you may make any hypothesis, if you like. I know no more than you do or than anybody does of the mechanism of death following disease—not more than we know of the mechanism of life. You may say that the chicken dies from the effect of poison, but you will be constrained to admit that it is the microscopical organism which gives rise to the poison.

If you are not satisfied with these arguments and proofs of a chemist, I will express the liveliest regret to find that I am not in harmony with one of the most distinguished members of this Academy.

At the conclusion of this paper Dr. Guérin took occasion to say that, for his part, he was not convinced, to which M. Pasteur retorted: "So much the worse for you," and Dr. Guérin said in effect that it was so much the worse for M. Pasteur.

At the meeting of June the 8th, Dr. Guérin engaged to utterly disprove the theories of M. Pasteur at some future meeting.

ON THE

MOLECULAR HEAT AND VOLUME OF THE RARE EARTHS AND THEIR SULPHATES.[*]

By L. F. NILSON and OTTO PETTERSSON.

At the request of the Royal Academy of Sciences at Stockholm, we some years ago undertook an extended research into the physical properties of the rare earth-metals and their compounds. Having performed the laborious task of separating and purifying their oxides, we are now able to publish our first series of determinations concerning their principal properties, which chemically are of the greatest importance, viz., molecular heat and molecular volume.

The rare earths, with a few exceptions (CeO_2, ThO_2, ZrO_2), belong to a group of sesquioxides. In order to obtain a larger number for comparison we have extended our research not only to the rare earths, but also to some other nearly related compounds, the molecular heat and volume of which were hitherto unknown. As to these values, previously known for some other oxides, Al_2O_3, Fe_2O_3, Cr_2O_3, according to Regnault, Kopp, and others, we have already observed in our preceding paper "On the Essential Properties and Chemical Character of Beryllium" that only such determinations are strictly comparable which are made by the same method, under the same circumstances, and referred to the same unit of measure.

The specific densities and molecular volumes, which are given in the following tables, are obtained by means of a method specially adapted to prevent the errors arising from adhesion of air to pulverulent substances.[†] The densities taken by this method will therefore generally be found a little higher and the molecular volumes a little lower than the numbers usually given by others.

---

[*] A Paper read before the Royal Society, Nov. 18, 1880.

[†] For the details see Otto Pettersson, "Molecularvolumina einiger Reihen von isomorphen Salzen," in "Nov. Act. reg. Soc. Scient. Ups.," ser. iii. Upsala, 1873.

The specific heats of the different compounds are determined with Bunsen's ice-calorimeter, by means of the same process which we have more fully described in our detailed memoir on beryllium.[*] All the numbers given are the means of at least two determinations, which agree perfectly, the experiments being made under the most favourable circumstances. As to the values obtained we beg to observe that the specific and molecular heat will be found a little smaller by the ice-melting method than by other methods, on account of the different unit of comparison.

The molecular weight of the different oxides was determined by a special analysis or synthesis of the sulphates, and the very same chemically pure substances were employed both for the thermic, volumetric, and magnetic experiments. The results only and not the details of these experiments are given in the tables.

Oxides.

	Molecular Weight.	Specific Weight.	Specific Heat.	Molecular Heat.	Molecular Volume.
Beryllium oxide—					
Be_2O_3	75·3	3·016	0·2471	18·61	24·97
Aluminium oxide—					
Al_2O_3	102·8	3·990	0·1827	18·78	25·76
Sapphire cryst.—					
Al_2O_3	102·8	3·990	0·1879	19·32	25·76
Chrysoberyl cryst.—					
$\left.\begin{matrix}Al_{\frac{2}{3}}\\Be_{\frac{1}{3}}\end{matrix}\right\}O_3$	95·9	3·734	0·2004	19·22	25·69
Scandium oxide[†]—					
Sc_2O_3	136·0	3·864	0·1530	20·81	35·19
Gallium oxide[‡]—					
Ga_2O_3	184·0	—	0·1060	19·50	—
Yttrium oxide—					
Y_2O_3	227·0	5·046	0·1026	23·29	44·99
Indium oxide—					
In_2O_3	274·8	7·179	0·0807	22·17	38·28
Erbium oxide[§]—					
Er_2O_3	380·0	8·640	0·0650	24·70	43·98
Ytterbium oxide—					
Yb_2O_3	394·0	9·175	0·0646	25·45	42·94
Lanthanum oxide—					
La_2O_3	326·0	6·480	0·0749	24·42	50·31
Didymium oxide—					
Di_2O_3	341·0	6·950	0·0810	27·62	49·07
Zirconium oxide—					
ZrO_2	122·0	5·850	0·1076	13·13	20·86
Cerium bioxide—					
CeO_2	171·5	6·739	0·0877	15·04	25·45
Thorium oxide—					
ThO_2	264·0	9·861	0·0548	14·47	26·77

Hitherto it was supposed to be a general rule, that the atomic heat of oxygen in any oxide was not less than 3·5 or greater than 5·1. The numbers above given compel us, however, to assign a still lower value to the atomic heat of oxygen in alumina and beryllia, viz., 2·34.[‖] Into these oxides it enters with a minimum capacity of heat and volume. From these earths upwards the molecular heat and volume of the sesquioxides gradually increase with increasing molecular weights.

The following table shows that the molecular heat (1) of Er_2O_3, Yb_2O_3, La_2O_3, and Di_2O_3 nearly agrees with those for other sesquioxides, determined by Regnault; (2) that of Be_2O_3 approaches to the same for alumina; and (3) of that ZrO_2, CeO_2, and ThO_2 is as high as the values for SnO_2, TiO_2, and zircon, determined by the same author, and for MnO_2 according to Kopp. The validity of Neumann's law receives hereby a new confirmation.

Formula.	Molecular Weight.	Specific Heat.	Molecular Heat.	Authority.
Bo_2O_3	69·8	0·2374	16·57	Regnault.
Cr_2O_3	152·4	0·1796	27·37	"
Fe_2O_3	160·0	0·1681	26·90	"
As_2O_3	198·0	0·1279	25·32	"
Sb_2O_3	292·0	0·0901	26·31	"
Bi_2O_3	468·0	0·0605	28·31	"
TiO_2	82·0	0·1703	13·97	"
$\left.\begin{matrix}Si_{\frac{1}{2}}\\Zr_{\frac{1}{2}}\end{matrix}\right\}O_2$ ..	90·8	0·1456	13·22	"
SnO_2	150·0	0·0933	14·00	"
MnO_2	87·0	0·1590	13·83	H. Kopp.

Anhydrous Sulphates.

	Molecular Weight.	Specific Weight.	Specific Heat.	Molecular Heat.	Molecular Volume.
Beryllium sulphate—					
Be_23SO_4	315·3	2·443	0·1978	62·37	129·07
Aluminium sulphate—					
Al_23SO_4	342·8	2·710	0·1855	63·59	126·50
Scandium sulphate—					
Sc_23SO_4	376·0	2·579	0·1639	62·42	145·80
Chromium sulphate—					
Cr_23SO_4	392·4	3·012	0·1718	67·41	130·27
Ferric sulphate—					
Fe_23SO_4	400·0	3·097	0·1656	66·24	129·16
Gallium sulphate—					
Ga_23SO_4	424·0	—	0·1460	61·90	—
Yttrium sulphate—					
Y_23SO_4	467·0	2·612	0·1319	61·60	178·80
Indium sulphate—					
In_23SO_4	514·8	3·438	0·1290	66·41	149·77
Lanthanum sulphate—					
La_23SO_4	566·0	3·600	0·1182	66·90	157·22
Cerium sulphate—					
Ce_23SO_4	567·0	3·912	0·1168	66·23	144·94
Didymium sulphate—					
Di_23SO_4	581·0	3·735	0·1187	68·96	155·55
Erbium sulphate—					
Er_23SO_4	620·0	3·678	0·1040	64·48	168·57
Ytterbium sulphate—					
Yb_23SO_3	634·0	3·793	0·1039	65·87	167·15
Thorium sulphate—					
Th_22SO_4	424·0	—	0·0972	41·21	—

The molecular heat of the anhydrous sulphates of the sesquioxides varies only within very narrow limits; 61·60

Hydrated Sulphates.

	Molecular Weight.	Specific Weight.	Specific Heat.	Molecular Heat.	Molecular Volume.
Beryllium sulphate—					
$Be_23SO_4.12H2O$	531·3	1·713	—	—	310·17
Yttrium sulphate—					
$Y_23SO_4.8H_2O$	611·0	2·540	0·2257	137·91	240·55
Lanthanum sulphate—					
$La_23SO_4.9H_2O$	728·0	2·853	0·2083	151·64	255·17
Cerium sulphate—					
$Ce_23SO_4.5H_2O$	657·0	3·220	0·1999	131·33	204·04
Didymium sulphate—					
$Di_23SO_4.8H_2O$	725·0	2·878	0·1948	141·23	251·91
Erbium sulphate[*]—					
$Er_23SO_4.8H_2O$	764·0	3·180	0·1808	138·13	240·25
Ytterbium sulphate[†]—					
$Yb_23SO_4.8H_2O$	778·0	3·286	0·1788	139·11	236·79

[*] According to Cleve.
[†] According to Nilson.

---

[*] *Pogg. Ann.* [2], iv., p. 554.

[†] According to Nilson.

[‡] For the oxide employed we are under obligation to M. Lecoq. de Boisbaudran, who placed 0·138 grm. gallium at our disposal.

[§] Prof. Cleve has kindly placed at our disposal the purest erbia he has been able to obtain.

[‖] See the preceding paper.

to 68·96 for yttrium and didymium sulphate. The values for the salts of chromium, iron, indium, lanthanum, cerium, and didymium are nearly identical; whilst even the values of the remainder approach each other very nearly.

As the hydrated sulphates (see preceding page) are decomposed when heated to 100°, their capacity of heat was determined between 0° and 46° in the vapour of boiling CS_2; the beryllium sulphate not bearing even that temperature without losing water, its molecular heat could not be ascertained.

On subtracting the values obtained for the anhydrous salts from the same numbers of the hydrated sulphates, we obtain a remainder expressing the molecular heat and volume of the water in combination. Thus the following values are obtained:—

Compounds.	Water in Combination.	Molecular Heat.	Molecular Volume.
Ytterbium sulphate ..	$8H_2O$	9·15	8·70
Erbium sulphate	$8H_2O$	9·21	8·96
Yttrium sulphate	$8H_2O$	9·54	7·72
Didymium sulphate..	$8H_2O$	9·03	12·04
Lanthanum sulphate .	$9H_2O$	9·42	10·88
Cerium sulphate	$5H_2O$	13·02	11·82

The molecular heat and volume of free water being = 18, it will be seen that by entering into combination with the sulphates of the rare earth-metals its heat and volume are reduced in an extraordinary degree. In fact, the molecular heat and volume of water in these salts descends to a minimum value hitherto unknown.

Comparing the values given above, we readily find that in those groups of compounds intimately connected by isomorphism the molecular heat of the compounds increases and the molecular volume decreases with increasing molecular weight of the compound or atomic weight of the element. This will be shown by the following table, in which the different isomorphous compounds, partly of yttrium, erbium, and ytterbium, partly of lanthamum and didymium, are brought into comparison:—

Elements.	Atomic Weight.	Oxides		Anhydrous sulphates.		Hydrated sulphates.	
		Molecular heat.	Molecular volume.	Molecular heat.	Molecular volume.	Molecular heat.	Molecular volume.
Yttrium	89·5	23·29	44·99	61·60	178·80	137·91	240·55
Erbium......	166·0	24·70	43·98	64·48	168·57	138·13	240·25
Ytterbium ..	173·0	25·45	42·94	65·87	167·15	139·11	236·79
Lanthanum..	139·0	24·42	50·31	66·90	157·22	—	—
Didymium ..	146·5	27·62	49·07	68·96	155·55	—	—

Especially with regard to beryllia and the question of its real composition, the values given above are of the greatest importance. In respect of this we observe that: 1st, the atomic heat of oxygen in beryllia is identical with that in alumina and nearly identical with the same value in other closely related oxides, if beryllia $=Be_2O_3$ (see our preceding paper); 2nd, under the same supposition the molecular heat and volume of beryllia and alumina are nearly identical, whether the latter earth be examined in the state of crystallised sapphire or of an amorphous powder, and, further, if we consider chrysoberyl not as an aluminate, but as $\left.\begin{matrix}Al_{\frac{3}{2}}\\ Be_{\frac{1}{2}}\end{matrix}\right\}O_3$, this mineral has yielded identical values; 3rd, the molecular heat and value of beryllium sulphate, compared with the same values for the other nearly allied sulphates of aluminium, scandium, gallium, and yttrium, support the formula, Be_2O_3 which we have given.

Taking into consideration the above-mentioned circumstances, and those related in our former papers, with the fact that the atomic heat and volume of metallic beryllium, as well as the molecular heat and volume of beryllia and its sulphate, would assume values quite exceptional, if the formula for the oxide were BeO, we think, therefore, the question of the valence of beryllium may be considered as finally decided. In fact, there is no physical property of beryllium, beryllia, or its sulphates, which does not testify to our view being the correct one, and from a chemical point of view the same holds good. It is, we think, unnecessary to take space up here with a repetition of the various reasons which support this conclusion. We refer, therefore, to our detailed paper on beryllium, above quoted, and only mention here that this metal belongs on account of its sulphate,

$$3K_2SO_4+Be_23SO_4,$$

to the series of the gadolinite and cerite metals, this salt having a composition typical for all the members of this series (Be, Sc, Y, La, Ce, Di, Tr, Y_α, Y_β, x, Er, Tm, Yb). The series of these elements, the leading member of which beryllium unquestionably is, stands certainly in the nearest proximity with another series, that of aluminium (Al_2, Ga_2, Tn_2, Cr_2, Mn_2, Fe_2), but this nevertheless decidedly differs from the former by another typical double sulphate,

$$K_2SO_4+R_23SO_4+24H_2O.$$

or alum.

The fact, which has been alleged as a proof of the bivalence of beryllium, namely that the chloride fuses and sublimes at a higher temperature than aluminium chloride is of no importance, for it will be found that amongst the members of the former series, with its difficultly fusible and volatilisable chlorides, many analogies exist for beryllium, not only in this, but in many other respects.

Lastly, we subjoin a table showing the magnetic properties of the rare earths. Mr. Knut Angström kindly undertook this research, employing a powerful electiomagnet of Ruhmkorff, between the poles of which the oxides showed the following properties:—

Magnetic.	Diamagnetic.
Cr_2O_3	Be_2O_3
Fe_2O_3	Al_2O_3
Y_2O_3	Sc_2O_3?
Di_2O_3	In_2O_3
Er_2O_3	La_2O_3
Yb_2O_3	—
—	ZrO_2
CeO_2	ThO_2

PRELIMINARY NOTE ON THE EXISTENCE OF ICE AND OTHER BODIES IN THE SOLID STATE AT TEMPERATURES FAR ABOVE THEIR ORDINARY MELTING-POINTS.*

By THOMAS CARNELLEY, D.Sc.,
Professor of Chemistry in Firth College, Sheffield.

In the present communication I have the honour to lay before the Royal Society a detailed description of experiments, proving that under certain conditions it is possible for ice and other bodies to exist in the solid state at temperatures far above their ordinary melting-points. On a future occasion I hope to submit to the Society a full account of the investigation of which these experiments form a part, together with the conclusions to be drawn therefrom. The bodies whose behaviour I propose to discuss at present are ice and mercuric chloride.

Ice.

In the case of ice the great difficulty to be overcome is to maintain the pressure in the containing vessel below 4·6 millims., *i.e.*, the tension of aqueous vapour at the freezing-point, for it will be easily understood that if the ice be but slightly heated the quantity of vapour given off would soon be sufficient to raise the pressure above that point. After several fruitless attempts the following plan, involving the principle of the cryophorus, was adopted.

---

* A paper read before the Royal Society, January 6, 1881.

A strong glass bottle, such as is used for freezing water by means of Carré's pump, was fitted with a cork and glass tube, and the cork well fastened down by copper wire and paraffin wax. The tube and bottle were then filled with mercury, and the bottle connected with the end of the tube by means of the piece of stout india-rubber pump tubing, a thermometer having been previously attached by a wire to the lip of the tube. The connection was made tight by fine copper wire and wax. The tube was about 1 inch in diameter, and about 4 feet long from the bend; after connection with the bottle it was completely filled with mercury, care being taken to expel the air as completely as possible; the whole was then inverted over the mercurial trough, when the mercury fell to 0, the ordinary height of the barometer. The mercury was run out by tilting up the bottle and inclining the tube. By this means a Torricellian vacuum was obtained in the flask and upper part of the tube. The tube was next brought to the vertical, and the bottle placed in a trough. A tin bottle without a bottom was fitted with a cork, so that it might slide somewhat stiffly along the vertical tube.

To begin with, the tin bottle was placed in position and filled with a freezing mixture of salt and ice. Some boiled water was then passed up the tube, sufficient to form a column about 2 inches deep. The thermometer had been previously arranged, so that its bulb might be one or two inches above the surface of the water. The bottle was next surrounded by a good quantity of a freezing mixture of salt and ice, in order that any vapour given off from the water in the tube might be condensed in the bottle as fast as it was formed, and thus the internal pressure might never be more than about 1·0 to 1·5 millims. When the bottle had been sufficiently cooled, which required about fifteen minutes, the tin vessel was slid down the tube and its freezing mixture removed. The water had then solidified to a mass of ice, which on heating with the flame of a Bunsen's burner melted either wholly or partially, and the liquid formed began at once to boil. The fusion commenced first at the bottom of the column of ice, whereas the upper part fused only with difficulty, and required rather a strong heat. The fusion in this case was probably due to the steam evolved from the lower portions of the ice column being imprisoned and unable to escape, and hence producing pressure sufficient to cause fusion.

When the greater part of the ice had been melted the tube was tightly clasped by the hand, the heat of which was sufficient to produce a somewhat violent ebullition. The liquid in boiling splashed up the side of the tube and on to the bulb of the thermometer, where it froze into a solid mass. By this means the ice was obtained in moderately thin layers. The tube at the points indicated by the arrows was then strongly heated by the flame of a Bunsen's burner, with the following results:—

The ice attached to the sides of the tube at first slightly fused, because the steam evolved from the surface of the ice next the glass being imprisoned between the latter and the overlying strata of ice could not escape, and hence produced pressure sufficient to cause fusion; but as soon as a vent-hole had been made fusion ceased, and the whole remained in the solid state, and neither the ice on the sides of the tube nor that on the bulb of the thermometer could be melted, however great the heat applied, the ice merely volatilising without previous melting. The thermometer rose to temperatures varying between 120° to 180° in different experiments, when the ice had either wholly volatilised or had become detached from the bulb of the thermometer. The ice attached to the latter did not partially fuse at the commencement of the heating, because, the heat reaching the outer surface of the ice first, evaporation could take place from a free surface and the vapour not become imprisoned, as was the case with the ice attached to the sides of the tube.

These experiments were repeated many times and always with the same result, except in one case in which the heat applied had been very strong indeed and the ice attached to the sides of the tube fused completely. On removing the lamp, however, for a few seconds the water froze again, notwithstanding that the portion of the glass in contact with it was so hot that it could not be touched without burning the hand.

The chief conditions necessary for success appear to be —(1) That the condenser is sufficiently large to *maintain* a good vacuum: in the present case the capacity was about three-quarters of a litre. (2) That the ice is not in too great mass, but arranged in thin layers. Further, in the case where the heat is applied to the under surface of the layers of ice, the latter must be sufficiently thin to allow of a vent-hole being formed for the escape of the steam coming from below, otherwise fusion occurs. When the heat is applied to the free surface of the ice the layers may be much thicker.

Mercuric Chloride,

m.p. = 288°, re-solidifies at 270° to 275°, b.p. = 303°.

About 40 grs. of pure mercuric chloride were place in a tube, and a thermometer arranged with its bulb imbedded in the salt. The drawn-out end of the tube was connected by stout india-rubber tubing with one branch of a three-wayed tube, whilst the other was attached to the manometer. The remaining branch was connected with a Sprengel pump, fitted with an arrangement for regulating the pressure.

When the pressure had been reduced by means of the pump to below 420 millims., the mercuric chloride was strongly heated by the flame of a Bunsen's burner, with the following results:—

Not the slightest fusion occurred, but the salt rapidly sublimed into the cooler parts of the tube, whilst the unvolatilised portion of the salt shrank away from the sides of the tube and clung tenaciously in the form of a solid mass to the bulb of the thermometer, which rose considerably above 300° C., the mercury of the thermometer shooting up to the top of the stem. After slight cooling the air was let in, and under the increased pressure thus produced the salt attached to the bulb of the thermometer at once melted and began to boil, cracking the tube at the same time.

The experiment was next varied as follows:—

About the same quantity of chloride was placed in the tube as before, and heated by the full flame of a Bunsen's burner. The lamp was applied during the whole of this experiment, and the size of the flame kept constant throughout. The mercuric chloride first liquefied and then boiled at 303° under ordinary pressure, and whilst the salt was still boiling the pressure was gradually reduced to 420 millims., when the boiling-point slowly fell to 275°, at which point the mercuric chloride suddenly began to solidify, and at 270° was completely solid, the pressure then being 376 millims. When solidification was complete the pump was stopped working, but the heat still continued to the same extent as before. The salt then rose rapidly to temperatures above that at which a thermometer could be used, but not the least sign of fusion was observed. From the completion of the solidification to the end of the experiment the pressure remained at about 350 millims.

The above experiment, which was repeated three times, shows, therefore, that when the pressure is gradually reduced from the ordinary pressure of the atmosphere to 420 millims., and the boiling-point simultaneously from 303° to 275°, the salt solidifies while it is still boiling and in contact with its own hot liquid, notwithstanding that it is being strongly heated at the same time; and that, after solidification is complete at 270°, the temperature then rises far above the ordinary boiling-point (303°) of the substance without producing any signs of fusion. Under ordinary circumstances, mercuric chloride melts at 288° and re-solidifies at 270° to 275°, *i.e.*, at a temperature identical with that at which it solidifies under diminished pressure, as above described.

The solid mercuric chloride obtained on solidification under the combined influence of diminished pressure and the application of a strong heat had a peculiar appearance, quite different to that produced when the substance is allowed to solidify in the ordinary way. It appeared to consist of a mass of pearly leaflets closely packed together round the bulb of the thermometer.

Any final explanation of these phenomena is reserved until further experiments have been made.

Appendix.

Since writing the foregoing, it has been said in explanation of the phenomena therein described, that the thermometer, though embedded in the mass of ice, did not really indicate the true temperature of the letter. With the object, therefore, of proving whether the ice is hot or not, I have, at the suggestion of Professor Roscoe, made the following calorimetrical determination:—

The arrangement of the apparatus was so modified that the ice, after being strongly heated, could be suddenly dropped into a calorimeter containing a known quantity of water of known temperature. The resulting temperature, after the ice had been dropped in, was read off by a thermometer graduated so as to indicate a difference of 0·05°C. The weight of the ice was found by re-weighing the calorimeter.

So far I have only had the opportunity of completing the two following determinations, and in the second of these the weight of the ice could not be found, as a small quantity of water was lost out of the calorimeter, owing to a sudden jerk at the moment the ice entered it:—

(1.) Weight of water in calorimeter, including the value of the latter = 185 grms.
Weight of ice dropped in = 1·3 grms.
Temperature of calorimeter before = 13·4°
" " after = 13·6°

Rise in temperature = 0·2°

$$M(\theta - t) + 80W = W(T - \theta)$$
$$(185 \times 0{\cdot}2) + (80 \times 1{\cdot}3) = 1{\cdot}3(T - 13{\cdot}6)$$
$$\therefore\ T = 122^\circ\ \text{C.}\quad \text{Where } T = \text{temperature of ice.}$$

(2.) Weight of water in calorimeter, &c. = 185 grms.
Temperature of calorimeter before = 12·7°
after = 12·8°

Rise in temperature = 0·1°

On weighing the calorimeter after the experiment, the increase in weight was only 0·15 grm., but as a portion of the water had been jerked out during the operation the true weight of the ice, and therefore its temperature, could not be found. But since the calorimeter had slightly risen in temperature, the ice must have been above 80° C.

From the nature of the experiment, as carried out on the present scale, the weight of the ice which can be dropped into the calorimeter is only small, and therefore the rise in temperature is but slight. But since a fall in temperature of a much larger amount ought to have been obtained had the ice been at 0°, it is considered that the above experiments are conclusive. Great care was taken in order to obtain correct temperatures in the calorimeter. The latter was inclosed in several casings, and the water was allowed to stand in it for several hours before the experiment, so that it might first attain the temperature of the room, whilst the time which elapsed between the readings of the thermometer before and after the ice was dropped in would not be more than from ten to fifteen seconds.

In the course of the next few weeks I intend to make one or two more determinations, and, if possible, on a larger scale.

Dependence of the Diffusion-Coefficient of Gases upon Temperature.—A. von Obermayer.—The author gives a table showing the absolute value of the diffusion-coefficients of five gases at 0°, and at the normal atmospheric pressure.—*Weiner Anzeiger*, 1880, 94-95.

ON THE

DETECTION AND DETERMINATION OF ARSENIC IN ORGANIC MATTER.[*]

By R. H. CHITTENDEN and H. H. DONALDSON.

THERE have been many different methods devised for the detection and determination of arsenic in organic matter, but few are entirely free from objectionable features, or sufficiently accurate to insure perfect reliance upon results obtained by their use. At the present day the toxicologist is expected to answer questions as to rapidity of absorption and rate of elimination, and is required to follow the track of the poison step by step in its course through the body. He has need of methods which will allow of its detection with certainty even though present in very minute quantity. And when by chemical evidence alone the toxicologist is required to state whether the poison has been introduced into the body long before death, or, in other words, whether it is a case of acute or chronic poisoning, none but the most accurate method will suffice to give the information needed. Recently Gautier,[†] recognising the need for physiological purposes of a more trustworthy method for the determination of arsenic in animal tissue, has described a new process which has in it many commendable features, but which requires reagents certainly not always obtainable in a state of purity or from arsenic, though a smaller number is needed than in the commonly used method of Fresenius and Babo.

That a method which requires ten or twelve different chemicals for its completion in the detection of arsenic is a dangerous one, especially in medico-legal cases, no conscientious worker can deny; and a method which involves the use of hydrogen sulphide for 12 to 24 hours will no doubt be gladly dispensed with by those toxicologists who have vainly spent days in the preparation of pure chemicals for the generation of this gas. The method which we have to propose has been suggested by the use of Gautier's process, and some portions of our method may be considered simply as modifications of his, while the method as a whole has to recommend it the following features: extreme accuracy, great delicacy, and the use of but three chemicals—nitric acid, sulphuric acid, and zinc.

I. *Method for the Complete Extraction of Arsenic from Organic Matter.*

Gautier's method of destroying the organic matter is based upon the older methods of Orfila[‡] and Filhol,[§] consisting of successive oxidations with nitric and sulphuric acids at elevated temperatures. The first part of our process is practically the same, except that we use a much lower temperature.

100 grms. of the suspected material, cut into small pieces, are placed in a porcelain casserole of 600 c.c. capacity and provided with a stirring rod of stout glass. 23 c.c. of pure concentrated nitric acid are added, and the dish placed on a small air-bath[‖] provided with a thermometer and a single Bunsen burner. The mixture is now heated at 150° to 160° C., with occasional stirring. At first the tissue takes on a yellowish colour, then swells up somewhat, becoming finally quite thick; soon changes again, becoming liquid, and then generally requires heating from $1\frac{1}{2}$ to 2 hours, the temperature sometimes being raised to 180° C.

At this point the mass, being now quite thick again, usually takes on a deeper yellow colour or orange shade. When this change of colour is noticed the casserole is

---

[*] Contributions from the Sheffied Laboratory of Yale College.—*American Chemical Journal*, vol ii., No. 4.

[†] *Bulletin de la Société Chimique*, 24, 250.

[‡] "Traité de Toxicologie", 1, 494. Paris, 1852.

[§] "Thesis." Paris, 1848.

[‖] For air-bath we use an ordinary flat-bottomed tin basin, 7 inches in diameter, 3 inches deep, with a cover provided with an opening 5 inches in diameter. This bath is set in an iron ring fastened to a stout lamp-stand, while the end of the thermometer passes through a small hole near the edge of the cover a short distance into the bath, so that the temperature can be regulated.

taken from the bath and 3 c.c. of pure concentrated sulphuric acid added and the mixture stirred vigorously. The addition of concentrated sulphuric acid to the viscid residue rich in nitric acid and nitro-compounds naturally gives rise, especially at this temperature, to a considerable commotion: the mass becomes brown, swells up, nitrous fumes are copiously evolved, immediately followed by dense white fumes of suffocating odour, while the residue in the dish is changed either into a dry carbonaceous mass or a black, sticky, tar-like mass. Although the oxidation is so powerful, no deflagration takes place, and the carbonisation is effected in this manner without the volatilisation of any arsenic. The casserole is again placed on the bath and heated for a few minutes at 180° C., then, while still on the bath, 8 c.c. of pure concentrated nitric acid are added drop by drop with continual stirring, the object being, as Gautier says, to destroy more completely the organic matter, and at the same time the nitric acid falling drop by drop on the carbonaceous residue tends to prevent the formation of sulphurous acid and the consequent formation of insoluble arsenious sulphide.

After the addition of the nitric acid the dish is heated at 200° C. for fifteen minutes, and when cold a hard carbonaceous residue is the result, entirely free from nitric acid. In working with different kinds of tissue, slight deviations from the above description will frequently be observed. When much bony matter is present the last residue takes on a somewhat different character, owing to the presence of calcium sulphate, and occasionally when the 3 c.c. of sulphuric acid are added the oxidation does not at once take place, but requires a little longer heating on the air-bath. But when such is the case the mixture needs constant watching in order to remove the dish from the bath at the first approach of the oxidation.

The arsenic now exists as arsenic acid, readily soluble in water. The carbonaceous residue is thoroughly extracted with boiling water, and in order to avoid all loss is not previously pulverised, but the casserole in which the oxidation took place is filled with water and heated on the water-bath for several hours. The hard mass soon softens, and by repeated treatment in this manner readily gives up all its arsenic to the aqueous solution; it is, however, better to have the carbonaceous residue in contact with different portions of warm water for about 24 hours to insure the complete extraction of the arsenic.

The reddish brown fluid containing some organic matter and arsenic acid is now evaporated on the water-bath to dryness, care being taken that the entire residue is finally obtained in one casserole. This residue[*] of organic matter and arsenic is dissolved in a definite quantity of a dilute sulphuric acid with the aid of gentle heat, and in that form, or, as frequently happens, in the form of a fluid with organic matter in suspension, is introduced into the Marsh apparatus in the manner about to be described, and the arsenic weighed in the metallic state.

The following results show the accuracy of the method:—

Quantity of Arsenic introduced.	Wt. of Metallic Arsenic found.	Theoretical Wt. Metallic Arsenic.
100 grms. beefsteak with—		
0·004 grm. As_2O_3	0·00300	0·00303
0·004 „ „	0·00300	0·00303
0·004 „ „	0·00290	0·00303
0·003 „ „	0·00219	0·00227
0·005 „ „	0·00369	0·00378
0·005 „ „	0·00372	0·00378

Thus, from the evidence here afforded, we have a method for the determination of arsenic which is extremely accurate, and, above all other things, a method which requires but three chemicals, none of which are extremely difficult to obtain pure, and this for medico-legal purposes is a desideratum long wished for.

II. *On the Marsh Apparatus.*

There is no method for the detection of arsenic which promises better results, either qualitatively or quantitatively, for toxical purposes, than the decomposition of arseniuretted hydrogen by heat. Indeed, no other method allows of the accurate detection of such minute quantities as the method of Marsh if properly conducted. In making use of this method as a test for arsenic in the usual manner no particular precautions have been taken to have all of the arsenio deposited in the heated tube, and in the qualitative tests for which this method has hitherto been generally used it is well known that the gas is only partially decomposed, and thus it has come to be the general impression that arseniuretted hydrogen is only partially decomposed by heat. The explanation of many poor results which have been obtained by decomposing arseniuretted hydrogen, formed from a known quantity of arsenious oxide, by heat and weighing the metallic arsenic, is not at all difficult. Otto[*] in describing some experiments on this point states that with 10 milligrms. of arsenious oxide he sustained a loss of 0·8 milligrm. the tube being heated by two lamps and the length of the experiment 1½ hours, while the arsenic was introduced in quantities of 1 milligrm.; but in those experiments in which the arsenic was introduced more rapidly and the time of the experiment shortened, the results were very much poorer.

Dr. Draper[†] in describing a new method for the determination of arsenic based on the decomposition of arseniuretted hydrogen by heat, proved experimentally that a rapid current of arseniuretted hydrogen passed through a tube heated at five different points by single Bunsen burners was not entirely decomposed, as was evinced by the presence of five distinct mirrors; but when the evolution of gas was very slow, the arsenic was nearly all stopped by the first burner. Thus the cause of the whole trouble, which is almost entirely a mechanical one, lies in the too rapid and irregular evolution of gas, the too rapid and irregular addition of the arsenical mixture, and insufficient length of heated tube.

Gautier[‡] in his recently described process for determining arsenic by the decomposition of arseniuretted hydrogen, has devised an improved arrangement for controlling the evolution of gas, by slowly introducing the arsenic mixed with a definite quantity of dilute sulphuric acid of known strength, later adding the same quantity of a stronger acid, and lastly a still stronger acid; the increasing strength of acid added counteracting the diluting effect of the reaction, so that the strength of acid remains about the same during the entire process of 2½ to 3 hours in the determination of 0·005 grm. of arsenious oxide. Gautier decomposes the gas by passing it through a tube heated with red coals for a distance of 20 to 25 centimetres.

In making use of the Marsh apparatus according to Gautier's plan, we have so modified it at the suggestion of Prof. S. W. Johnson that it now appears to combine all the essentials of a perfect apparatus.

The flask, a Bunsen's wash-bottle of 200 c.c. capacity, is provided with a small separating funnel of 65 c.c. capacity, with glass stop-cock. This is a very material aid to the obtaining of a slow and even evolution of gas, a very important desideratum when all loss is be avoided; for with only a funnel tube, every time a small portion of fluid is added a sudden rush of gas takes place, with probably a small but still more or less appreciable loss. But the separating funnel filled with the acid mixture can be so arranged as to give a constant and regular supply of fluid at the rate of two or three drops per minute, more or less.

---

[*] When the residue left by the evaporation of the water is quite large, it is sometimes better to reoxidise it. This is quickly accomplished by adding a few c.c. of concentrated nitric acid to the contents of the casserole and heating on the air-bath at 150 to 180° C. until a reddish solution is obtained. Then 3 to 5 c.c. of concentrated sulphuric acid are added and the mixture heated at the above temperature until the nitric acid is completely driven off. The thin black fluid is then carefully mixed with the requisite quantity of No. 2 acid, shortly to be described, and introduced into the Marsh apparatus. Frequently quite a heavy, flocculent precipitate separates from the sulphuric acid solution. This does not interfere, but is poured, together with the fluid, directly into the receiving bulb, which is purposely provided with a delivery tube of large calibre.

[*] *Anleitung zur Ausmittelung der Gifte*, 1875, 122.

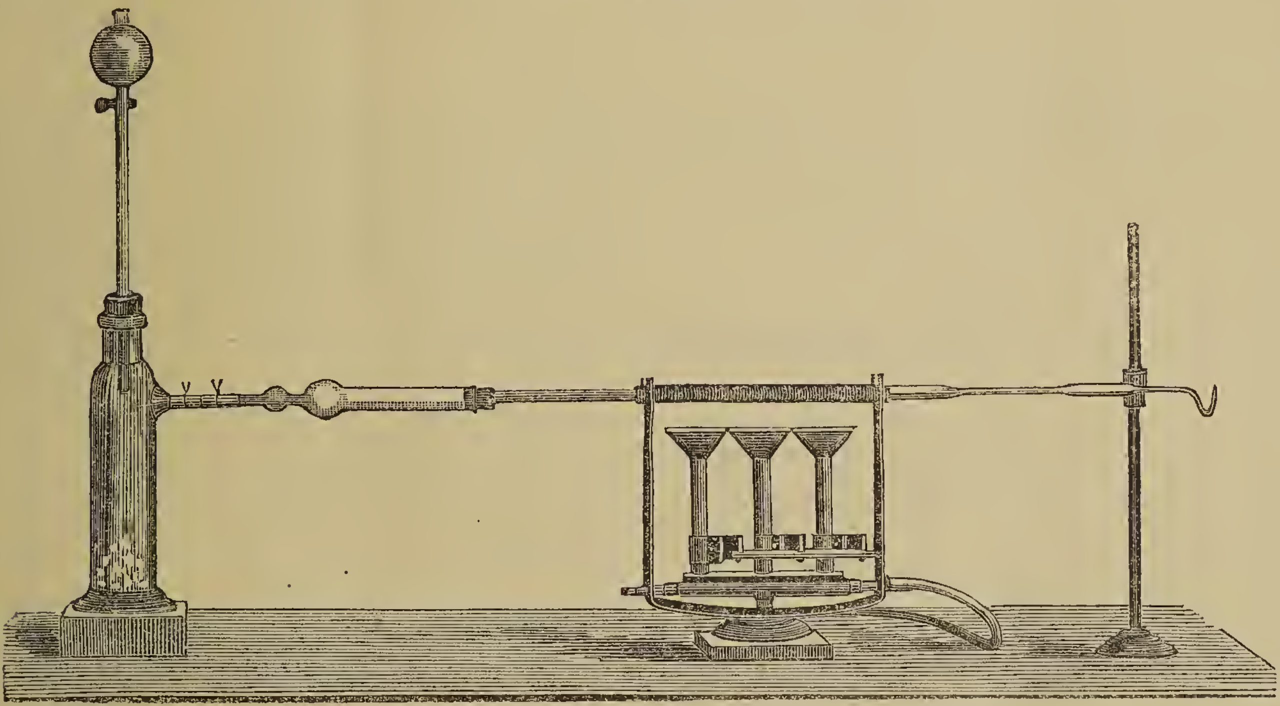
[†] *American Chemist*, ii., 456.

[‡] *Bulletin de la Société Chimique*, xxiv., 258

The gas generated is dried by passing through a calcium chloride tube, and then passes through a tube of hard glass, heated to a red heat by a miniature furnace of three Bunsen lamps with spread burners, so that a continuous flame of six inches is obtained, and with a proper length of cooled tube not a trace of arsenic passes by. The glass tube where heated is wound with a strip of wire gauze, both ends being supported upon the edges of the lamp frame, so that the tube does not sink down when heated. The small furnace is provided with two appropriate side pieces of sheet metal, so that a steady flame is always obtained. When the quantity of arsenic is very small the tube is naturally so placed that the mirror is deposited in the narrow portion, but when the arsenic is present to the extent of 0·005 grm. the tube should be 6 m.m. in inner diameter, and so arranged that fully two inches of this large tube are between the flame and the narrow portion. When the quantity of arsenic is less the tube can naturally be smaller.

The acids of different strengths, and which for convenience we prepare in considerable quantities, are made as follows:

Acid No. 1.	Acid No. 2.
545 c.c. pure conc. H_2SO_4.	109 c.c. pure conc. H_2SO_4.
5000 c.c. H_2O.	1640 c.c. Acid No. 1.



Acid No. 3.	Acid No. 4.
218 cc. pure conc. H_2SO_4.	530 cc. pure conc. H_2SO_4.
1640 cc. Acid No. 1	1248 cc. H_2O.

25—35 grms. of granulated zinc previously alloyed with a small quantity of platinum are placed in the generator, and everything being in position, the apparatus is filled with hydrogen by the use of a small quantity of acid No. 2. After a sufficient time has elapsed the gas is lighted at the jet, and the glass tube heated to a bright redness.

The arsenical solution in concentrated form is mixed with 45 c.c. of acid No. 2, and the mixture passed into the separating funnel, from which it is allowed to flow into the generator at such a rate that the entire fluid is introduced in one hour or one and a half; 40 c.c. of acid No. 3 are then added and allowed to flow slowly into the generator, and lastly 45 c.c. of acid No. 4. The amount of time required will vary with the amount of arsenic: 2—3 milligrms. of arsenic will require about two to three hours for the entire decomposition, while 4—5 milligrms. will need perhaps three to four hours. Where the amount of arsenic is small, only 25 grms. of zinc are needed, and but 45 c.c. of acid No. 2, 30 c.c. of acid No. 3, and 30 c.c. of acid No. 4; but when 4—5 milligrms. of arsenic are present, it is better to take the first mentioned quantities of zinc and acids.

The arsenic being thus collected as a large or small mirror of metal, the tube is cut at a safe distance from the mirror, so that a tube of perhaps 2—6 grms. weight is obtained. This is carefully weighed and then the arsenic removed by simple heating; or, if the arsenic is to be saved as in a toxical case, dissolved out with strong nitric acid. The tube is then cleaned, dried, and again weighed, the difference giving the weight of metallic arsenic, from which, by a simple calculation the amount of arsenious oxide can be obtained. The results are exceedingly satisfactory, as is shown by the following, which were obtained by introducing definite quantities of arsenious oxide in the form of a solution mixed with 45 c.c. of No. 2 acid, &c.

Quantity of Arsenic introduced.		Wt. of Metallic Arsenic found.	Theoretical Wt. of Metallic Arsenic.
0·005 grm.	As_2O_3	0·00373	0·00378
0·005 ,,	,,	0·00370	0·00378
0·004 ,,	,,	0·00300	0·00303
0·002 ,,	,,	0·00151	0·00151

In order to ascertain how delicate the detection of arsenic by this form of apparatus is, the following tests were made, using carefully prepared standard solutions of arsenious oxide and accurately graduated burettes.

Quantity of Arsenic introduced.			
0·0001	grm.	As_2O_3	distinct mirror.
0·00001	,,	,,	,, ,,
0·000001	,,	,,	,, ,,
0·0000001	,,	,,	no mirror visible.

Thus we have the $\frac{1}{1000}$th of one milligrm. of arsenious oxide as the smallest quantity to be detected by this form of the Marsh apparatus.

Wormley* finds the limit when the amount of fluid is small and the apparatus likewise small, $\frac{1}{500000}$th of one grain of arsenious oxide, which is equal to 0·0000001296 grm. of arsenious oxide. That 0·000001 grm. of arsenious oxide is the limit under any circumstances we have proven by taking 0·0000001 grm. and introducing this quantity into a very small apparatus with strong acid, &c., obtaining a negative result.

III. *Influence of Organic Matter on the Separation of Arsenic as Arseniuretted Hydrogen.*

Dr. T. Boeke, of Holland, in a recent paper on the detection of arsenic in organic mixtures † says—"The admirable method of Marsh in its improved form allows

---

* "Micro-Chemistry of Poisons," 287.

† Chemical News, vol. xli., p. 177.

the detection of the minutest trace of arsenic, even in the most complicated mixtures, but with one restriction, viz., that the solution to be examined be wholly free from organic matter." This statement expresses the prevalent opinion in regard to the influence of organic matter on the Marsh test; but the following experiments, of which those given are but a few of the many tried, show how erroneous such an opinion is. In conducting these experiments with organic matter, after the zinc is placed in the generator, 15 drops of sweet oil are allowed to flow down the side, and this as the fluid is introduced floats on top and thereby prevents any troublesome frothing. The only other thing to be guarded against is the too rapid introduction of the acids, whereby loss as well as frothing of the mixture may ensue; and, secondly, the heating of the flask by the chemical reaction. If necessary this latter can be prevented by placing the generator in a glass or other dish so that a stream of cold water can continually play about it, which will keep the flask sufficiently cool to prevent the formation of any hydrogen sulphide which might otherwise show itself in slight quantity.

The first experiments were made with urine:—

Quantity of Arsenic introduced.	Wt. of Metallic Arsenic found.	Theortcl. Wt. of Metallic Arsenic.
0·00475 grm. As_2O_3 in 50 c.c. urine	0·00350	0·00359
0·00470 ,, ,, ,, ,,	0·00352	0·00356
0·00001 ,, ,, ,, ,,	distinct mirror	
0·000001 ,, ,, ,, ,,	,,	,,
0·00001 ,, ,, in 250 c.c. urine concentrated to 50 c.c.	,,	,,

Thus it becomes very plain that arsenic contained in urine to the extent of 0·000001 grm. can be detected with certainty, its organic matter not offering any appreciable hindrance.

Mayençon and Bergeret[*] have devised a new method for the detection of minute traces of arsenic, which they have designed especially for ascertaining the rate of elimination of arsenic by the kidneys. They introduce the urine directly into a flask in which hydrogen is being generated, and ascertain the presence of arsenic by testing the gas as it issues from the end of the tube by means of a paper moistened with mercuric chloride solution, a yellow stain on the paper showing the presence of arsenic. The yellow stain is due to the formation of a compound which, according to H. Rose[†], contains 1 atom of arsenic, 6 of mercury, and 3 of chlorine. By means of this reaction they were able to obtain a yellow colour in five minutes by introducing one-tenth c.c. of a fluid containing 5 grms. per litre of potassium arsenate. As this amount is equivalent to but 0·000193 grm. of arsenious oxide it cannot be considered extremely delicate, and certainly a method which is dependent entirely on a particular shade of colour as an indicator of the presence of the substance looked for is hardly to be compared with such an exact method as that of Marsh. Tests were now made with organic matter in the form of extractive matter from 100 grms. of tissue. A large number of oxidations of lean beef in portions of 100 grms., made as already described with nitric and sulphuric acids, were extracted with boiling water, and the so-obtained aqueous extract evaporated to a thick residue. To each residue from 100 grms. of beef definite quantities of arsenious oxide were added in solution, then 45 c.c. of acid No. 2, and this mixture introduced into the Marsh apparatus recently described.

Quantity of Arsenic introduced.	Wt. of Metallic Arsenic found.	Theoretical Wt. of Metallic Arsenic.
0·001 grm. As_2O_3 in extract from 100 grms. beef ..	0·00070	0·00075
0·001 grm. do. do.	0·00075	0·00075
0·002 grm. do. do.	0·00150	0·00151
0·002 grm. do. do.	0·00150	0·00151
0·003 grm. do. do.	0·00220	0·00227
0·003 grm. do. do.	0·00220	0·00227
0·004 grm. do. do.	0·00290	0·00303
0·004 grm. do. do.	0·00290	0·00303
0·005 grm. do. do.	0·00369	0·00378
0·005 grm. do. do.	0·00369	0·00378
0·005 grm. do. do.	0·00375	0·00378
0·005 grm. do. do.	0·00375	0·00378
0·00001 grm. do. do... ..	distinct mirror	
0·000001 grm. do. do. ..	faint mirror	

The results are given in preceding column.

Thus we have abundant evidence that the organic matter which is present here in considerable quantity does not interfere in the least with the recovery of the entire amount of arsenic. Naturally care must be taken that the stronger acid No. 4 does not flow into the generator too rapidly, as it may thereby produce an uncontrollable frothing; the presence of the oil, however, is sufficient to prevent frothing under proper circumstances.

NOTICES OF BOOKS.

Exercises in Practical Chemistry. (Vol. I.) *Elementary Exercises.* By A. G. VERNON HARCOURT, F.R.S., Sec. C.S., and H. G. MADAN, F.C.S. Third edition; revised by H. G. Madan, F.C.S. (Clarendon Press Series.) Oxford: Clarendon Press. London: H. Frowde.

THIS work has certain features which appeal strongly to our sympathies. It is written entirely without reference to any examination whatever, and aims at furnishing a course of study for those who are beginning to learn practically. The object of the authors is plainly to teach the arts of experiment and observation, and the equally important process of drawing right conclusions from the phenomena witnessed. Chemistry studied in this manner is not a mere heap of names and figures and symbols overburdening the memory, but a valuable course of discipline for all whom it concerns to draw just inferences from facts rightly observed—a discipline which the physical sciences only are able to afford.

We think that the student who carefully and conscientiously follows the course of instruction here given is in a fair way to become an accurate worker. The introductory memoranda are worthy of being engraved in the mind of every beginner. We are especially delighted with the closing paragraph, which shows that the authors look upon the student as an embryo discoverer who, not content with fixing in his own mind what has been already ascertained, is to add his quota to the sum-total of human knowledge: "Nor, again, give up hopes of making discoveries in the science because the land already appears to be highly farmed and you have not all the refined apparatus which the optician and the operative chemist can supply. Records of close and accurate observations of some of the (apparently) simplest phenomena of chemistry are much needed; and such it is in the power of every student to contribute."

We feel bound to wish this book a wide circulation and appreciative readers, or rather workers.

The Electric Light in Buchanan Street, Glasgow.—The first application in Glasgow of electricity to street lighting in a permanent form took place recently at the new *Herald* Buildings in Buchanan Street. The proprietors have also contracted with Messrs. Anderson and Munro, electric engineers, Glasgow, to light up the public offices and the composing rooms of the *Herald* and the *Evening Times* by electricity. The Gramme machines are those used, driven by an Otto gas-engine, supplied by Messrs. P. Watt and Sons—gas thus curiously so far superseding itself. This gas-engine also works the cyclic elevator in use during the day. The electric lamps are those invented by Mr. Brockie, formerly of Glasgow.

---

[*] *Comptes Rendus*, 79, 118.

[†] "Handbook of Chemistry," 4, 267. Leopold Gmeiin.

CORRESPONDENCE.

HISTORY OF BLEACHING-POWDER.

To the Editor of the Chemical News.

Sir,—In his paper (Chemical News, vol. xli., p. 1) Dr. Lunge says that the two compounds $Ca(OCl)_2+CaCl_2$ "are assumed by most chemists to exist in *solutions* of bleach."

Dr. Lunge appears to have forgotten my paper on this subject, published in the *Journal of the Chemical Society* for May, 1875, wherein were described the proceedings whereby I had succeeded in isolating tolerably pure calcic hypochlorite from solutions of bleaching-powder.

Perhaps I may be excused for regarding my investigation as one which furnished the strongest proof of the correctness of Odling's formula for bleach.—I am, &c.,

C. W. Kingzett.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, l'Académie des Sciences. No. 23, December 6, 1880.

Spectral Reaction of Chlorine and Bromine.—M. Lecoq de Boisbaudran.—If we observe in the gas flame, by the old procedure, the spectrum of a little globule of barium chloride, the rays peculiar to this compound soon disappear, and give place to those of the oxide. Still chlorine remains for a long time in the baryta thus heated, and the destruction of the barium chloride is only complete after its volatilisation. Thus on passing the induction-spark over the ignited mass we see very distinctly the nebulous rays peculiar to barium chloride, in addition to the narrow rays of barium. For the detection of traces of chlorine or bromine I proceed as follows:—A straight platinum wire, of about ¾ m.m. in diameter, is bent at its lower part in the form of a hook, or of a U. Upon the bend is melted, at white redness, from 0·001 to 0·002 grm. of pure barium carbonate, and then there is placed in the curve of the wire a small drop of the liquid to be examined; it is evaporated to dryness, and the heat is pushed for a moment to incipient redness. The fusion, partially at least, of the mass is advantageous, permitting it to spread like a varnish over the surface of the platinum wire. When it is cold a second platinum wire, of about ¾ m.m. in diameter, is brought very near (0·001 to 0·0015 metre), below the curve of the first wire and a little in advance of the slit of the spectroscope. The induction-spark, not condensed, gives then a spectrum in which the rays of barium chloride or bromide may be detected. About 1-3000th of a m.grm. of chlorine or bromine may thus be recognised, and doubtless with special precautions even this degree of sensibility may be surpassed, especially in case of chlorine. If the quantity of chlorine is at all considerable the wire may be heated to full whiteness for some minutes without prejudice to the rays of $BaCl_2$. The resistance of the bromide to heat seems to be much less. If the matter in question contains nitrates it is useful to expel the nitric acid with sulphuric acid, and remove this again with pure barium oxide.

On Radiophony.—E. Mercadier.—The author gives the name radiophony to the phenomenon lately observed by M. G. Bell, in which a radiation rendered intermittent according to a given period produces, on falling upon bodies cut in plates, a sound of the same period. He finds that radiophony does not appear to be an effect produced by the mass of the recipient plate vibrating transversely in its totality like an ordinary vibrating plate. The nature of the molecules of the recipient and their mode of aggregation do not seem to exert a predominating influence upon the nature of the sounds produced. The radiophonic sounds result from the direct action of the radiations upon the recipients, and principally a surface action. The effects are relatively very intense, and seem to be principally produced by the so-called thermic radiations.

On the Existence of Perboric Compounds.—A. Etard.—The author refers to a former paper, in which he places boron at the head of the vanadium group of elements. He has obtained barium perborate,—

$$Bo_2O_7BaH_4+H_2O,$$

a white, amorphous, insoluble salt, which at 100° loses 1 mol. water, and at dull redness is converted into barium borate, losing 24·2 per cent of water and oxygen. He finds, also, that whilst an equimolecular mixture of magnesium sulphate, ammonium chloride, and ammonia is not rendered turbid either by oxygenated water or by boric acid, a mixture of the two precipitate it abundantly, acting as perboric acid.

On the Cobaltamines.—N. Porumbaru.—The author has prepared and examined purpureo-cobaltamine pyrophosphate.

Researches on the Saxifrages.—MM. Garreau and Machelart.—The authors have extracted from the stems of these plants tannin, starch, and a new proximate principle, bergenine, which possesses valuable medicinal properties, and may rank between quinine and salicine.

Chemisches Central-blatt.
No. 29, 1880.

Contamination of Platinum Chloride with Gold Chloride.—W. Gintl.—This impurity is due to gold which has been used for soldering platinum vessels, and is very inconvenient in the determination of alkali. It is removed by shaking up the concentrated solution with ether.

On Hop-Bitter and Hop-Resin.—M. Issleib.—The author recognises a peculiar bitter principle both in hops and in lupuline. It is decomposed by acids, but yields no sugar, and hence belongs to the pseudo-glucosides. The lupuliretine thus obtained differs from hop-resin by the absence of H_2O.—*Archiv. Pharm.*, 16, 345.

On Cynurenic Acid.—L. Brieger.—The author examines the yellow matter obtained by Baumann on adding bromine water to solutions of cynurenic acid.—*Z. f. Phys. Chem.*, 4, 89-92.

Volatile Phenols whose Ether Sulpho-acids occur in Human Urine.—L. Brieger.—Of these compounds, paracresol is the most abundant. Phenol is found in small quantities, and orthocresol in mere traces.—*Z. f. Phys. Chem.*, 4, 204.

No. 30, 1880.

The Changes of Molecular Weight and Molecular Refractive Power.—J. V. Janovsky.—The author arrives at the result that isomers have no equal refraction-index and that the correct molecular refractive power can only be determined by means of the formula of Landolt and Gladstone and Dale, when the optical relations of the different series are known.—*Wein Anzeiger*, 103, 1880.

Solubility of Organic Bodies.—Aug. Belohoubek.—In many bodies containing carbon, hydrogen, and oxygen, the solubility depends not on the smaller number of the C-atoms, but on the number of the O-atoms in the molecule. Compounds free from oxygen are insoluble, but the richer they are in oxygen the more readily do they dissolve. Two compounds mutually dissolve each other the more similar is their structure.—*Listy. Chem.*, 4, 10.

MEETINGS FOR THE WEEK.

Monday, 17th.—London Institution, 5.
— Medical, 8.30.
— Royal Geographical, 8.30.
Tuesday, 18th.—Civil Engineers, 8.
Wednesday, 19th.—Society of Arts, 8. "Causes of Success and Failure in Modern Gold Mining," Alfred G. Lock, F.R.G.S.
— Meterological, (Anniversary), 7.
— Geological, 8.
Thursday, 20th.—London Institution, 7.
— Royal, 4.30.
— Philosophical Club, 6.30.
— Chemical, 8. "On some Hydrocarbons Present in Resin Spirit," H. E. Armstrong, F.R.S. "Determination of the Relative Weight of Single Molecules," E. Vogel. "On the Oxidation of Organic Matter in Water," Arthur Downes, M.D. "Analyses of Queensland Soils," Prof. Liversidge.
Friday, 21st.—Royal Institution, 8. "The Phenomena of Electric Discharge with 14,400 Chloride of Silver Cells," Mr. Warren De La Rue, 9.
— Society of Arts, 8. "Forest Conservancy in India," Sir Richard Temple, Bart., G.C.S.I.
Saturday, 22nd.—Physical, 3. "On the Measurement of Small Resistances and on a Method of Comparing the Capacities of Two Condensers," R. T. Glazebrook.

THE JOURNAL OF SCIENCE

for JANUARY (Price 1s. 6d.), includes—

Life and its Basis. By J. H. Barker, M.A.
Atlantis and Lemuria: The Distribution of Land and Sea.
Industrial Training. By An Old Technologist.
Comparative Psychology.
The Materialistic Origin of the Sexes. By Andrew Dewar, Author of "Origin of Creation."
Analyses of Books. Correspondence. Notes.

London: 3, Horse-Shoe Court, Ludgate Hill.

ROYAL SCHOOL OF MINES.

DR. FRANKLAND, D.C.L., F.R.S., will commence a Course of Thirty Lectures on "Organic Chemistry," at the Science Schools, South Kensington, on MONDAY NEXT, the 17th inst., at 12 at noon, to be continued on each succeeding Wednesday, Friday, and Monday at the same hour. Fee, £3; or to those who have attended the Inorganic Course, £2.

F. W. RUDLER, Registrar.

AMMONIACAL LIQUOR.

THE DIRECTORS OF THE BRISTOL UNITED GAS LIGHT COMPANY invite TENDERS for the PURCHASE of the AMMONIACAL LIQUOR made at all or either of their THREE STATIONS, situate respectively at AVON STREET, CANONS' MARSH, and STAPLETON ROAD, in the Borough of Bristol, for a TERM of FIVE or SEVEN YEARS, commencing on 1st JULY, 1882.

The Annual Quantity of Liquor produced at present at the three Stations is about 2½ millions of gallons.

Conditions of Contract and other particulars may be obtained of he SECRETARY, at the Office of the Company, Canon's Marsh, Bristol.

Tenders to be delivered on or before TUESDAY, 3rd day of May next, addressed to the Chairman of the Company, and marked 'Tender for Ammoniacal Liquor."

The Directors do not bind themselves to accept the highest or any Tender.

HENRY H. TOWNSEND, Secretary.
Gas Offices, Canons' Marsh, Bristol,
8th January, 1881.

MR. J. S. MERRY,

ASSAYER AND ANALYTICAL CHEMIST,

SWANSEA.

Wanted, to Purchase Volumes 1, 3, 5, 6, and 7, of the "Journal of the Chemical Society"; also Vol. 3 of the "Proceedings of the Royal Society."—Address, K. P. G., Chemical News Office, Boy Court, Ludgate Hill, London, E.C.

ROYAL POLYTECHNIC.—Utopia, a Grand Fairy romance. The Electrical Railway; Great Lightning Inductorium; a Lecture on Scientific Wonders, by Mr. J. L. King. Musical Sketches, by Mr. Eric Lewis. Christmas and its Customs by Mr. Frank Heath. Humorous Recitals, by Madame Hickson. Blondin, Leotard, Diving Bell, &c. Admission to the whole, 1s, Open from 11 till 5, and from 6 till 10.

CITY AND GUILDS OF LONDON INSTITUTE FOR THE ADVANCEMENT OF TECHNICAL EDUCATION.

SPRING COURSES OF

LECTURES AND LABORATORY INSTRUCTION

At the Temporary Class-Rooms of the Institute,
COWPER STREET, FINSBURY,
Commencing January 24th, 1881.

CHEMICAL TECHNOLOGY—Professor ARMSTRONG, Ph.D., F.R.S.

Evening Courses—
- Coal-Tar Products—Mondays.
- Photography—Wednesdays.

Day Courses—
- Coal-Gas and its Uses as an Illuminating and Heating Agent—Fridays.
- Junior Chemistry—Introduction to Theory and Practice—Tuesdays and Thursdays.

PHYSICAL TECHNOLOGY—Professor AYRTON, A.M. Inst. C.E.

Evening Courses—
- Electrical Instrument Making—Tuesdays.
- The Electric Light—Fridays.

Day Courses—
- Motor Machinery—Mondays.
- Junior Electricity and Magnetism—Wednesdays and Thursdays.

Fees for Lectures and Laboratory Course together—5s. and 7s. 6d.

Laboratory open Daily from 10 to 1 and from 2 to 5.

Detailed Prospectus to be had on application to the Professors at Cowper Street; or to—

PHILIP MAGNUS, Director and Secretary.
Gresham College, E.C., January, 1881.

BERNERS COLLEGE of CHEMISTRY.

Instruction and preparation in CHEMISTRY and the EXPERIMENTAL SCIENCES under the direction of Professor E. V. GARDNER, F.A.S., M.S.A.

The Class Rooms are open from 11 to 5 a.m. and from 7 to 10 p.m daily.

Especial facilities or persons preparing for Government and other examinations.

Private Pupils will find every convenience.

Analyses, Assays, and Practical Investigations connected with Patents, &c., conducted.

Prospectuses and full particulars on application to Prof Gardne at Berners College, 44, Berners-street W.

BISULPHITE OF LIME.
BISULPHITE OF SODA.
SULPHITE OF SODA. TANNATE OF SODA.

WILLIAM MARRIOTT
CHEMICAL WORKS, HUDDERSFIELD

Silicates of Soda and Potash in the state of Soluble Glass, or in CONCENTRATED SOLUTION of first quality, suited for the Manufacture of Soap and other purposes, supplied on best terms by W GOSSAGE and Sons, Soap Works, Widnes, Lancashire.

London Agents, COSTE and Co., 19 and 20, Water Lane, Tower Street, E.C., who hold stock ready for delivery.

THE CHEMICAL NEWS

AND

JOURNAL OF PHYSICAL SCIENCE.

Edited by WILLIAM CROOKES, F.R.S.

Published every Friday. Price 4d. Annual Subscription, post free including Indices, £1

CHARGES FOR ADVERTISEMENTS.

	£	s.	d.
Five lines in column (about 10 words to line)	0	3	6
Each additional line	0	0	6
Whole column	1	15	0
Whole page	3	0	0

A reduction made for a series of insertions.

Cheques and Post-Office Orders, crossed "London and County Bank," payable to the order of William Crookes.

BOY COURT, LUDGATE HILL LONDON, E.C.

THE CHEMICAL NEWS.

Vol. XLIII. No. 1104.

ON THE ABSORPTION SPECTRA OF COBALT SALTS.[*]

By W. J. RUSSELL, Ph.D., F.R.S.,
Treas. C.S., Lecturer on Chemistry at the Medical School,
St. Bartholomew's Hospital.

The following investigation was commenced with Mr. Lockyer, and although he has been unable to continue the work, the author is indebted to him for much aid and many suggestions.

The cobalt salt first examined was the anhydrous chloride. In order to establish clearly its absorption spectra, different samples of this salt were made by various processes. All, however, gave the same spectrum. The bromide of cobalt yields a similar spectrum, but its position is different—it is nearer to the red.

On fusing cobalt chloride with potassic chloride, a greenish blue mass is formed, which gives a spectrum entirely different from that of the chloride when alone. Judging from the fusing-point of the mixture being lower than that of the components, and the cobalt salt not decomposing in this mixture on fusion in contact with air, it seemed natural to suppose that a new compound had been formed, and that it gave rise to the new spectrum. Further experiment showed, however, that this is not the case for other solid chlorides, such as of sodium and zinc give with cobalt chloride the same spectrum; and liquids in which the cobalt chloride easily dissolves, such as ordinary or amylic alcohol, the saline ethers, glycerine, and hydrochloric acid, also give the same spectrum; in fact, this spectrum is produced whenever cobalt chloride dissolves freely in any menstruum without definitely combining with it. A careful set of experiments were made in the case of the solid chlorides, to exclude the presence of water, for it was possible that the spectrum in all the above cases might be due to a trace of water, which, by its combining with the cobalt chloride, formed in every instance the spectrum-giving body.

The bromide and iodide of cobalt, when fused with potassium bromide and potassium iodide respectively, give results corresponding to those of the chloride, but the bands in the spectrum of the bromide, and still more so those of the iodide, are nearer to the red than the corresponding bands of the chloride. The action of heat and of water on the bodies producing these spectra is discussed, and it is pointed out how the definite compound with zinc was indicated by the spectrum. The action of the liquids which easily dissolve the cobalt chloride is next described, and from all giving the same spectrum, and this spectrum being identical with that obtained with the fused chlorides, the conclusion is that, as before stated, this spectrum must be that of the cobalt chloride, only, owing to solution, it is in a molecular state, different from that obtained on fusing this salt alone. This spectrum, as obtained from the hydrochloric acid solution, is remarkable for its persistence under varying circumstances, and for its being a reaction of great delicacy.

Hydrochloric acid as a solvent for the cobalt chloride differs in one respect from all the other solvents which have as yet been examined, namely, that, whether much or little cobalt be dissolved in it, the spectrum is the same; whereas with dry alcohol, for instance, a saturated, or nearly saturated, solution gives the spectrum above mentioned, but a diluted solution, one containing about 20 grms. of the chloride in 100 c.c. of alcohol, gives a spectrum somewhat different: a new band appears and others present before fade out, and if this dilution be carried on still further, so that only about 0·008 grm. of the chloride be present in 100 c.c. of alcohol, an entirely different spectrum is obtained, but on carrying the dilution beyond this no further change takes place. With other liquids which dissolve the cobalt salt freely, a similar series of changes occur, but if liquids in which the chloride is much less soluble be used, then according to their solvent power only the first (or most dilute stage), or the first and second stage, is obtainable; for instance, if dry ether is used as the solvent, it yields only a spectrum corresponding to the first stage. With anhydrous acetic acid, in which the cobalt chloride is more freely soluble, both the first and second stage are obtainable. If the dry chloride in fine powder be shaken up with the liquid in which it is insoluble, such as carbon tetrachloride, then only a spectrum similar to that of the fused chloride is visible.

The anhydrous cobalt chloride dissolved in water gives a pink solution. This solution, when it contains as little as 0·1 grm., or as much as 25 grms., of the salt in 100 c.c. of water, gives a wide absorption-band, shading off on both sides, and whether a short column of the strong solution or a correspondingly long column of the dilute solution be examined, identical spectra are obtained, so that within these limits the same compound appears to exist in the solution. If, however, the solution approaches saturation (100 c.c. of water can dissolve at 16° 32 grms. of the cobalt chloride), then another spectrum is visible, and this is again the spectrum of the dissolved chloride. The same as was shown to be obtained either by dissolving cobalt chloride in fused patassium chloride, or in alcohol, or in hydrochloric acid, it is apparently the anhydrous chloride existing in an aqueous solution. The action of heat, and the action of bodies capable of combining with water, in aqueous solutions of cobalt chloride, are identical, both tending to destroy the broad absorption-band of the hydrate, and to form the banded spectrum of the dissolved anhydrous chloride.

The very characteristic spectrum of the oxide of cobalt is well known. The precipitate obtained by the addition of potash or soda to any cobaltous salt shows well this spectrum. If ammonia be the precipitate, a somewhat simpler spectrum is obtained. Vogel has already pointed out the similarity of the spectrum of a piece of cobalt glass and this oxide spectrum. The glass spectrum is apparently identical with the spectrum formed by the precipitate with potash and soda; probably then the extra band visible in these cases and not when ammonia is used, is due to a compound of the alkali and cobalt. The bearing of these spectra on Winkler's supposed cobaltate of potash is then discussed. Further, it is shown that if the above precipitation of oxide be made in solutions in which the cobalt salt is in excess, or even if precipitated oxide be warmed or shaken up in the cold with a solution of cobalt chloride, a new compound is formed, an oxychloride which gives a different spectrum; its formation and its decomposition by water is well traced in the varying spectra producible from it, and goes hand in hand with the chemical changes which occur. From the spectroscopic appearance it is argued that the blue precipitated oxide is not a hydrate, but that it does very readily undergo change as the mere alteration of colour which takes place shows. Aqueous solutions of the bromide and iodide of cobalt when acted on by alkalies undergo changes similar to those which the chloride undergoes, and, as in the former cases, the iodide spectrum is always nearer the red end of the spectrum than the corresponding bromide spectrum, and the bromide than the chloride spectrum.

The salts of the oxygen acids when in aqueous solution do not give sharp banded spectra as the haloid salts do, but only a large shading off absorption like the hydrate of the cobalt chloride.

The other points discussed in detail are, first, the nature of the precipitate formed by the action of sodic or potassic carbonate on a cobaltous salt, and it is shown that the formation of the oxide always found in this precipitate is

---

[*] Abstract of a paper read before the Royal Society, November 18, 1880.

owing to an after decomposition, the precipitate as first formed being entirely free from all oxide, and it gradually appearing after a short time. The other point is the action of heat on cobalt phosphate dissolved in fused microcosmic salt; when cold there appears somewhat indistinctly a banded spectrum of a phosphate; on heating this the spectrum disappears, and the spectrum of the oxide very distinctly takes its place; on cooling, the first spectrum returns, and this change may apparently be repeated any number of times.

Drawings of all the different spectra are given in the full paper.

NOTE ON CHICKEN CHOLERA.

By C. T. KINGZETT, F.C.S., F.I.C.

Many readers of the important communications which Pasteur has recently made to the Academy of Sciences, and translations of which have appeared in recent issues of the Chemical News (vol. xlii., p. 321, and vol. xliii., pp. 5 and 16), must have remarked that which I now wish to point out.

In explaining the protective influence of repeated inoculations with the attenuated virus of chicken cholera, against the more virulent forms of this disease, Pasteur finds it "impossible to resist the idea that the microscopic germ which causes the disease, finds in the body of the animal conditions suitable to its development, and that to satisfy the necessities of its life the germ alters certain substances, or destroys them, which comes to the same thing, whether it assimilates them or whether it consumes them with oxygen borrowed from the blood."

So, again, in cases where complete immunity has been attained, the birds "no longer contain food for the germ."

More striking still is the following passage in reference to chickens which are born proof against cholera:—"Animals in this condition may be said to be born vaccinated for this disease, because the fœtal evolution has not placed in their bodies the proper food of the parasite, or because substances which could serve as such food have disappeared while they were yet young."

Now whether or not we may be prepared to regard the said parasite as the direct cause of the disease, it is remarkable that the reasoning of Pasteur should have culminated in the conclusion upon which Liebig insisted with considerable power.

If we turn to Gregory's (3rd) edition of Liebig's "Animal Chemistry" (p. 205) we find the following passage:—"The condition which determines, in a second individual, his liability to the contagion, is the presence in his body of a substance which by itself, or by means of the vital force acting in the organism, offers no resistance to the cause of change in form and composition operating on it. If this substance be a necessary constituent of the body, then the disease must be communicable to all persons; if it be an accidental constituent, then only those persons will be attacked by the disease in whom it is present in the proper quantity and of the proper composition. The course of the disease is the destruction and removal of this substance: it is the establishment of an equilibrium between the cause acting in the organism which determines the normal performance of its functions and a foreign power by whose influence these functions are altered."

I repeat that to me it seems somewhat remarkable that the investigations and reasoning of two such eminent (and in many matters diametrically opposed) thinkers should have culminated in the same conclusion as regards the conditions of the living body which subject it to, or protect it from, infection.

While, however, it can be readily understood how a profuse growth of parasites could quickly alter or destroy a comparatively large amount of substance—as, for instance, happens in ordinary putrefaction—it does not appear to me so easy to accept Pasteur's reasoning as to his so-called vaccination.

In this inflicted process an attenuated virus is introduced into the body of a chicken which becomes ill but does not die. It does not die because, if Pasteur be correct, the parasites do not sufficiently multiply. Why do they not multiply? It cannot be on account of the insufficiency of the pabulum, for in the large majority of cases where death results this seems to arise from the very profusion of the growth of the parasite when more freely introduced.

Can it be expected, therefore, that even, say, in three successive inoculations the substance which I have here spoken of as pabulum can be entirely removed or destroyed by the very limited number of parasites which are introduced by the inoculations, and which so soon perish in the body? I think this cannot be expected; but if it may be, then the particular substance or substances upon which the parasites prey must be extremely limited in quantity. After all, we are faced with the enormous difficulty of ascertaining the nature of such substance, and the further equally great difficulty of understanding why an undiscovered and undetermined substance should be entirely absent from the bodies of some animals and present in varying proportions in others.

Here we come in contact with the weakest point in the parasitic theory. The immunity from a second attack of an infectious disease of the class in question is simply inexplicable under the parasitic theory. We are forced back to an alternative theory, and that is one of which we at present only recognise the beginnings.

ON THE GRAINS OF SILICA AND MICROCOCCI OF THE ATMOSPHERE.

By Dr. T. L. PHIPSON, F.C.S., &c.

At the period of the great debate on spontaneous generation between M. Pasteur and Pouchet, the latter was the first to draw attention to the fact that some of the minute spherical granulations discovered by the microscope in dust deposited from the air in various regions of the globe, were essentially composed of silica. That they had often been mistaken for eggs of infusoria or for micrococci was very evident; but when the dust was submitted to complete calcination in a platinum crucible the same grains were still visible, with the same forms and dimensions as before.

I have more than once repeated this experiment of Pouchet's, but I have also made the opposite one and examined the action of heat upon micrococci, diatoms, and oscillariæ, which are supposed to contain large quantities of silica.

There is no doubt that the dust of the atmosphere reveals to the microscope, besides the larger mineral fragments mostly of an angular shape, exceedingly minute circular or spherical bodies, having often not more than 0·001 of a millimetre in diameter, and very similar in size and shape, which resist the action of a white heat in contact with the air, and that of strong hydrochloric acid. In some of my observations they were remarkably numerous. Both before and after the action of heat they are more or less transparent. What can be the origin of these singular objects?

The same experiments repeated with siliceous algæ, such as those belonging to the large family of the *diatomaceæ*, and with the *micrococci* of impure waters or vegetable infusions, showed me that they do not retain their forms after being subjected to the above treatment, and that in many instances they can be totally destroyed by heat on the object glass itself. On the other hand, the fossil diatoms resisted the action of heat and acids and retained their forms. I can only draw one conclusion from these observations: namely, that the minute siliceous bodies found in the atmosphere are also fossil—they are micrococci of another age.

SOME EXPERIMENTS ON MALTOSE.*

By H. YOSHIDA,
Graduate of the University of Tokio, Japan.

THE maltose used in the following experiments was extracted from a substance called *amé*, used in Japan as a sweetmeat, as well as for some other purposes. This substance is prepared from steamed rice by the action of an extract of malt, and when boiled down forms a clear yellow thickly viscid liquid. Different specimens contain from 45 to 75 per cent maltose, 8 to 38 per cent dextrin, and 8 to 16 per cent of water. The separation of the maltose from the dextrin was effected by their different solubilities in strong alcohol, and subsequent crystallisation from that solution. 300 c.c. of the *amé* syrup were diluted with a little water, then poured into a flask containing two litres of alcohol of specific gravity 0·83, and the whole boiled for about thirty minutes. The flask was provided with an inverted condenser to prevent loss of alcohol. The flask was then removed from the water-bath, and after cooling the liquid was filtered from the pasty mass of dextrin. The several alcoholic extracts obtained in this way were distilled over the water-bath until almost the whole of the alcohol was removed, and the liquid reduced to about one-eighth of its volume. This syrup was again exhausted with twice its volume of strong alcohol (sp. gr. = 0·8) with slight warming. After cooling the solution was decanted and set aside; after three days, crystals of maltose had formed, which were purified by re-crystallisation until the properties of the substance showed that it was pure. This was the case after the third crystallisation.

The specific rotatory power was determined by means of a Soleil Ventzky saccharimeter by the use of the formula—

$$[\alpha]j = \frac{n \times 0{\cdot}3961}{l \times m}$$

Where n = number of divisions through which the scale was turned.

l = length of tube in decimeters.

m = number of grains of solid matter in 1 c.c. of solution.

The number 0·3961 for converting divisions into degrees of rotation was determined by Mr. U. Watanabe very carefully with a solution of pure cane-sugar, using the number 73·8° to express the specific rotatory power of cane-sugar for the transition-tint. Experimenting with the maltose above obtained the following are the results:—

TABLE I.

m. Grains of Maltose in 1 c.c. of Solution.	l. Length of Tube.	n. Divisions Rotated.	$[\alpha]j$. Specific rotatory Power.
0·0642 gr.	2	48·7	150·1
0·0642 ,,	2	48·8	150·5
0·1000 ,,	2	75·8	150·1
0·1000 ,,	2	76·0	150·4
		Mean ..	150·25

The cupric oxide reducing power was determined by weighing the cupric oxide obtained by igniting the red oxide thrown down with the addition of a few drops of hydric nitrate. The maltose solution contained 8·196 grs. in 1 litre. 40 c.c. of Fehling's solution were diluted with about 200 c.c. of water, heated in a water-bath, and 20 c.c. of the above solution of maltose added, and the heating continued for twenty minutes. The reduced cuprous oxide was rapidly filtered, well washed, and finally burnt after the addition of a few drops of hydric nitrate, and weighed. The weight of cupric oxide obtained was in four experiments, 0·2206, 0·2203, 0·2211, 0·2205; mean, 0·2206 gr. CuO. The amount of maltose used was 0·1639 gr., and—

$$\frac{0{\cdot}1639}{0{\cdot}2206} = \frac{\text{mol. weight of maltose}}{n \times \text{mol. weight CuO}} = \frac{342}{5{\cdot}81 \times 79{\cdot}2}$$

1 molecule of maltose, therefore, corresponds to 5·81 molecules of cupric oxide, the equivalent number for glucose being 5. The cupric oxide reducing power calculated for this is—

$$x = \frac{100 \times 100}{0{\cdot}1639} = 61{\cdot}01.$$

Mr. O'Sullivan gives it = 65, while Messrs. Brown and Heron make it 60·8 as a mean of six experiments. The number above obtained may be a little too high, but is much nearer to the result obtained by the later observers.

Experiments were next made with the ammoniacal solution of tartrate of copper, recommended by Dr. Pavy in 1879. This method is based upon the complete solubility of cuprous oxide in strong ammonia, the result being the formation of a colourless liquid, and by noting the amount of sugar solution required to decolourise a given volume of the ammoniacal copper solution, the quantity of the sugar in a given sample can easily be calculated. The solution was first prepared according to Dr. Pavy's directions: 120 c.c. of the ordinary Fehling's solution were mixed with 300 c.c. of ammonia (sp. gr. = 0·88), and the whole made up to 1 litre.

The process was first tested with dextrose, and afterwards with maltose. The results are given together in the following tables. 1 c.c. of the dextrose solution used contained 0·005 grm., and that of the maltose 0·0081936 grm. The amount of copper solution used in each experiment was 40 c.c. (CuO = 0·0529776 grm.).

TABLE II.

	Copper solution used. c.c.	Dextrose solution required. c.c.	Maltose solution required. c.c.
1.	40	4·8	5·2
2.	40	4·75	5·2
3.	40	4·75	5·2
4.	40	4·80	5·2
	Mean ..	4·77	5·2
Ratio of molecule of sugar to cupric oxide ..		1 : 5·03	1 : 5·38

With the addition of 10 grms. of caustic potash to 40 c.c. of the original ammoniacal copper solution, the results given in Table III. were obtained.

TABLE III.

	Copper solution used. c.c.	Dextrose solution required. c.c.	Maltose solution required. c.c.
1.	40	4·0	4·30
2.	40	4·1	4·25
3.	40	4·0	4·30
4.	40	4·0	4·30
	Mean ..	4·02	4·29
Ratio of sugar to cupric oxide ..		1 : 6	1 : 6·5

Further experiments were made to ascertain the effect of using different strengths of ammonia in preparing the copper solution. Table IV. gives the results obtained with a copper solution prepared with 300 c.c. of ammonia of sp. gr. 0·93, other things as before.

TABLE IV.

	Copper solution used. c.c.	Dextrose solution required. c.c.	Maltose solution required. c.c.
1.	40	4·0	5·1
2.	40	4·0	5·1
3.	40	3·95	5·05
4.	40	4·0	5·15
	Mean ..	3·99	5·1
Ratio of sugar to cupric oxide ..		1 : 6	1 : 5·5

---

* Abstract of a thesis presented on graduating, July, 1880.—R.W.A.

With the addition of 10 grains of potash to 40 c.c. of the solution prepared as above described, the results in Table V. were obtained.

TABLE V.

	Copper solution used. c.c.	Dextrose solution required. c.c.	Maltose solution required. c.c.
1.	40	4·65	4·1
2.	40	4·75	4·15
3.	40	4·75	4·1
4.	40	4·65	4·1
	Mean ..	4·70	4·11
Ratio of sugar to cupric oxide	..	1 : 5·1	1 : 6·8

A third copper solution was prepared by using 350 c.c. of ammonia of specific gravity 0·88.

TABLE VI.

	Copper solution used c.c.	Dextrose solution required. c.c.	Maltose solution required. c.c.
1.	40	3·8	5·3
2.	40	3·85	5·25
3.	40	3·80	5·35
4.	40	3·75	5·3
	Mean ..	3·8	5·3
Ratio of sugar to cupric oxide	..	1 : 6·3	1 : 5·2

It will be seen from these results that the ratio of the number of molecules of sugar and of cupric oxide found by experiment is greatly influenced by slight differences in the strength of the ammonia employed, so that whenever this test is resorted to, the copper solution must be standardised against a known amount of sugar before it can be used. With dextrose the ratio of 1 : 5 is obtainable only by the use of ammonia of the strength and amount recommended by Dr. Pavey. The same ratio does not hold for maltose solutions, but it is to be noticed that differences in the strength of the ammonia used cause less marked changes than in the case of dextrose.

The addition of an extra amount of potash, however, appears to increase very largely the oxidising action of the copper solution upon maltose. The reduction of copper solution by maltose also takes place much more slowly than with dextrose.

In heating the solution the burette was joined by a piece of india-rubber tubing to a piece of glass tube, which ended in a fine point, and was bent so as to remove the flask in which the liquid was heated away from the neighbourhood of the burette.

In this way the sugar solution was not heated by the hot air rising from the sand bath upon which the flask rested.

The ammonia vapours were led into water.

The accompanying figure shows the arrangement of the apparatus.

Action of Hydric Nitrate on Maltose.—The method of Heintz for preparing saccharic acid from cane sugar was exactly followed as described in "Watts's Dictionary," vol. v., p. 142. The solution of the acid potassium salt after four crystallisations from hot water yielded distinct prisms of a light straw-colour. The acid was prepared according to the directions given by Baltzer (*Bull. Soc. Chim.*, 1868, p. 263) by carefully neutralising the solution of the acid salt with potassic carbonate, then boiling the solution with the addition of a small quantity of cadmic nitrate for one hour. The precipitate was collected, decomposed by sulphuretted hydrogen, and the solution evaporated at a temperature of 30° C. and finally over oil of vitriol *in vacuo*. A light coloured brittle mass was obtained, which on combustion gave the following numbers:—

1. 0·5234 grm. gave 0·6521 grm. CO_2 and 0·2271 grm. H_2O
2. 0·6344 ,, 0·7909 ,, 2·2975 grm. H_2O

	I.	II.	Mean.	Calculated for $C_6H_{10}O_8$.
Carbon ..	33·98	34·00	33·99	34·29
Hydrogen ..	4·82	5·21	5·02	4·76

The acid was highly deliquescent, soluble in alcohol, and its colour darkened when heated on the water-bath. A smooth mirror of reduced silver was obtained when a mixture of the acid and silver nitrate with ammonia was heated. Although therefore the percentage of hydrogen found is not very good, the percentage of carbon and the properties of the substance indicate that it really is saccharic acid.

A portion of the acid potassium salt was ignited, and the potassium weighed as sulphates. The potassium in two experiments was found to be 19·62 per cent and 19·15 per cent. The calculated percentage is 15·77, and it is evident, therefore, that the salt was impure, and probably contained in admixture some of the normal salt. Another portion of the crystals was dissolved in water, and completely neutralised with potassic carbonate, evaporated, and allowed to stand. A crystalline deposit separated, which was collected, re-crystallised, and the potassium determined as sulphates.

	I.	II.	Mean.	Calculated $C_6H_8K_2O_8$.
Potassium ..	27·41 per cent	27·52	27·46	27·34

There is, therefore, little doubt that that saccharic acid is formed by the action of hydric nitrate upon maltose.

Action of Chlorine in presence of Water upon Maltose.—About 10 grains of maltose were dissolved in half a litre of water, and a stream of chlorine gas passed through the solution for three days. The excess of chlorine was then expelled by a stream of carbonic acid, and the clear colourless solution then heated over the water-bath and completely neutralised with freshly prepared moist oxide of silver. The liquid was quickly filtered, and the residue repeatedly washed with boiling water. The brownish coloured filtrate, which had now become somewhat turbid, was subjected to the action of hydric sulphide gas, the precipated argentic sulphide filtered off, and the acid solution concentrated over the water-bath. After neutralising with milk of lime, the filtered solution was precipitated by lead acetate, and the precipitate after washing decomposed by sulphuretted hydrogen. This solution on evaporation yielded a dark, very acid syrup, which did not become dry, even after long standing over oil of vitriol *in vacuo*. A portion of the syrup was dissolved in a small amount of water, completely neutralised with milk of lime, and filtered. On heating the filtrate to 100° C. a crystalline deposit separated, which was collected and re-crystallised. After drying at 118—120° C. it gave the following numbers on analysis:

1. 0·6244 grm. substance gave 0·5842 grm. CO_2; 0·2429 grm. H_2O; and 0·2678 grm. residue.
2. 0·7831 grm. substance gave 0·7371 grm. CO_2; 0·3108 grm. H_2O; and 0·3338 grm. residue.

These numbers give—

	1.	2.	Mean.
Carbon..	25·52	25·67	25·59
Hydrogen	4·32	4·41	4·36
Residue ($CaCO_3$)	42·88	42·62	42·70

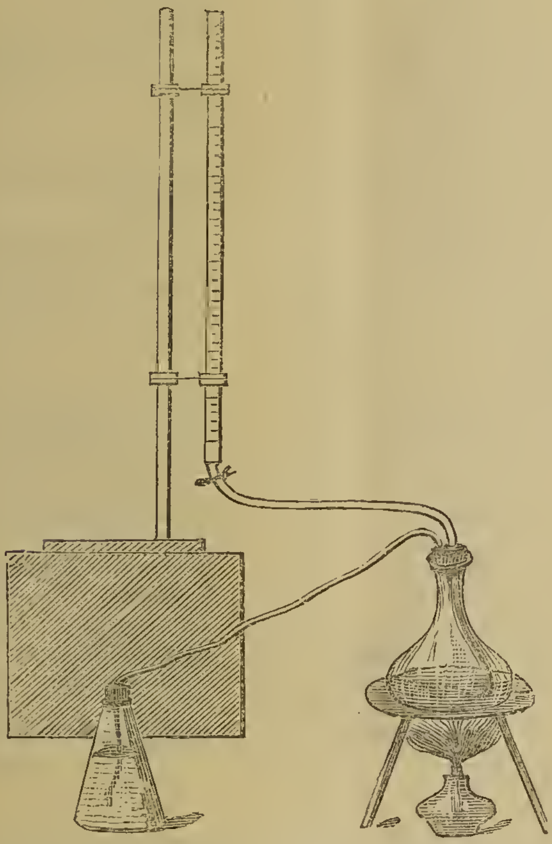
And if we add the carbon contained in the residue we get the following:—

	Mean of 1 and 2	Calculated for $C_6H_{10}CaO_7$.
Carbon	30·72	30·77
Hydrogen	4·46	4·27
Calcium	17·08	17·08
Oxygen (difference)	47·74	47·88
	100·00	100·00

Another sample ignited over the blowpipe gave the following amount of lime (CaO):—

			P.c. Ca.
1. 0·5431 grm. substance gave	0·1310 grm. CaO	=	17·23
2. 0·4462 ,, ,,	0·1061 ,,	=	16·69
	Mean		17·11

Maltose, therefore, like cane-sugar and dextrose, yields gluconic acid on oxidation with chlorine in presence of water. Experiments were made, using potassic permanganate to oxidise the maltose, but no conclusive results were obtained. Much heat was evolved during the reaction, and the solution, after removing manganese by sulphuretted hydrogen, gave a white precipitate with calcic chloride, which, after being dried at 100° C., contained in two experiments 33·03 and 33·11 per cent of calcium. Calcic oxalate contains 31·25 per cent of calcium.



Action of Glacial Acetic Acid upon Maltose.—A mixture of 2 parts of maltose, 1 part of acetic anhydride, and 5 parts of glacial acetic acid were heated to 110° C. in an open vessel. A dark coloured mass was obtained, which was found to be a mixture of several bodies. It was first treated with warm water: the filtrate, after evaporation, was exhausted with alcohol, and the solution filtered. The alcoholic solution was then mixed with twice its volume of ether, which precipitated a small quantity of a light yellow body. After being dried at 100° C. the substance gave the following numbers on combustion:—

1. 0·4321 grm. substance gave 0·6805 grm. CO_2 and 0·273 grm. H_2O.
2. 0·5224 grm. substance gave 0·8317 grm. CO_2 and 0·3174 grm. H_2O.

	1.	2.	Mean.	Calculated for $C_{12}H_{21}O_{11}(C_2H_3O)$.
Carbon..	42·95	43·42	43·19	43·75
Hydrogen	7·02	6·75	6·88	6·25

The numbers are not as close as might be desired, but considering the difficulty of purification they indicate that the substance insoluble in ether was the mon-acetyl derivation of maltose. It was at first sweet to the taste, but became afterwards bitter; it reduced Fehling's solution.

The other portions were not further examined owing to press of time.

ON THE
APPLICATION OF ORGANIC ACIDS TO THE EXAMINATION OF MINERALS.*

(Second Paper.)

By H. CARRINGTON BOLTON, Ph.D.

26. The behaviour of minerals with organic acids has already formed the subject-matter of two papers read before the Academy in 1877 and 1878, and we now present the results of a continuation of our researches.

In our first paper† we described several new methods of attacking minerals, and their application to ninety-five specimens; in this we extend our investigation to one hundred and five additional minerals. These methods of decomposition were as follows:—

(1.) Treatment with a cold saturated solution of citric acid.
(2.) Treatment with a boiling solutiou of the same.
(3.) Heating with a saturated solution of citric acid to which sodium nitrate is added.
(4.) Heating with a saturated solution of citric acid to which ammonium fluoride is added.

And in a second paper, under another title,‡ we added a fifth reaction:—

(5.) Heating with a concentrated solution of citric acid to which potassium iodide is added.

Similar reactions with oxalic, tartaric, acetic, and other organic acids were described in the first paper, but preference is given to citric acid on account of its greater solvent power.

Minerals belonging to several groups were submitted to these processes, and gave phenomena which may be summarised as follows:

(1.) More or less complete decomposition and solution of oxides, phosphates, &c., without formation of precipitates or liberation of gases.
(2.) Complete solution of carbonates with evolution of carbonic anhydride.
(3.) Decomposition of sulphides with evolution of sulphuretted hydrogen.
(4.) Decomposition of sulphides with oxidation of the sulphur.
(5.) More or less perfect decomposition of silicates with separation of either slimy or gelatinous silica.
(6.) Decomposition of certain species by reagents forming characteristic precipitates.
(7.) Wholly negative action.

These facts demonstrated that citric acid has a power of decomposing minerals little less than that possessed by hydrochloric acid, and that this very difference in degree gives the organic acid an advantage over the mineral acid in the determination of species.

27. This peculiar selective power of citric acid rendered desirable a further study of its action on a larger number of minerals; the following list contains the names of the species which have since been submitted to the process named, together with their formulæ, condition, and locality.

Within the groups,—(1), sulphides, arsenides, tellurides, &c.,—(2), oxides,—(3), silicates, and—(4), sundries, the minerals are arranged in the order in which they are given in "Dana's System of Mineralogy."

We desire to express our thanks to Prof. Thomas Egleston, of the School of Mines, Columbia College, who has again placed us under obligations by supplying many of the rarer minerals.

---

* Read before the New York Academy of Sciences and the Chemical Section of the British Association, Swansea Meeting, 1880.

† *Annals N.Y. Acad. Sci.*, vol., i., p. 1.

‡ "Behaviour of Natural Sulphides with Iodine and Other Reagents." *Annals N.Y. Acad. Sci.*, vol. i., p. 153.

I. SULPHIDES, ARSENIDES, &c.

Mineral.	Formula.	Description.	Locality.
Sulphur	S_2	massive	Humboldt, Nev.
Realgar	AsS	crystalline	Hungary.
Orpiment	As_2S_3	crystals	Hungary.
Bismuthinite	Bi_2S_2	in quartz	Clear Creek, Col.
Domeykite	Cu_3As_2	massive	Chili, S.A.
Clausthalite	$PbSe$	—	Tilkerode, Hartz.
Alabandite	MnS	crystalline	Mexico.
Hessite	$AgTe$	—	Boulder, Col.
Tiemannite	$HgSe$	incrusting	Clausthal, Hartz.
Millerite	NiS	crystalline	Lancaster Co., Pa.
Linnaeite	$2CoS+CoS_2$	crystals	Müsen, Prussia.
Cobaltite	$Co(S,As)_2$	grains	Tanaberg, Sweden.
Leucopyrite	$FeAs_2$	massive	Breitenbrun, Saxony.
Nagyagite	$2(Pb,Au)+3(Te,Sb,S.)$	foliated	Austria.
Covellite	CuS_2	massive	Germany.
Berthierite	$FeS+Sb_2S_3$	crystalline	Braunsdorff, Saxony.
Jamesonite	$2(Pb,Fe)S+Sb_2S_3$	fibrous	—
Pyragyrite	$3AgS+Sb_2S_3$	massive	Chili.
Proustite	$3AgS+As_2S_3$	massive	Chili.
Boulangerite	$3PbS+Sb_2S_3$	massive	—
Tennantite	$4(CuFe)S+As_2S_3$	crystalline	Cornwall, England.
Stephanite	$5AgS+Sb_2S_3$	massive	Mexico.
Polybasite	$9(AgCu)S+(Sb,As)_2S_3$	massive	—
Enargite	$3CuS+As_2S_5$	massive	Gilpin, Co., Colorado.
Kermesite	$2SbS_3+SbO_3$	crystalline	Braunsdorff, Saxony.

II. OXIDES.

Melaconite	CuO	massive	Copper Harbour, L.S.
Corundum	Al_2O_3	white, massive	North Carolina.
Menaccanite	$(Ti,Fe)_2O_3$	crystals	Ilmen Mts., Russia.
Washingtonite	$(Ti,Fe)_2O_3$	crystals	Litchfield, Conn.
Spinel	$MgOAlO_3$	crystals	Franklin, N.J.
Chrysoberyl	$BeOAlO_3$	crystals	Brazil.
Cassiterite	SnO_2	crystals	Cornwall, England.
Rutile	TiO_2	crystals	York, Pa.
Braunite	$2Mn_2OMnO_2+MnO_2SiO_2$	crystalline	Thuringia.
Goethite	FeO_3HO	crystalline	Easton, Pa.
Gummite	$(UO_3FeO_3)+2HO$	amorphous	North Carolina.
Quartz	SiO_2	crystals	Conn.
Hyalite	SiO_2+aq	mammillary	Waltsch, Bohemia.

III. SILICATES.

Enstatite	$MgOSiO_2$	massive	North Carolina.
Hypersthene	$(MgOFeO)SiO_2$	massive	Labrabor.
Petalite	$(\frac{1}{5}R_3O+\frac{4}{5}RO_3)3SiO_2+3SiO_2$	massive	Sweden.
Pargasite	$(R_3ORO_3)\ (SiO_2Al\frac{2}{3}O_3)$	massive	Diana, N.Y.
Actinolite	$(CaOMgOFeO)SiO_2$	crystals	Oxbow, N.Y.
Asbestus	$(R_3ORO_3)\ (SiO_2Al\frac{2}{3}O_3)$	silky fibrous	—
Beryl	$(\frac{1}{2}Be_3O+\frac{1}{2}AlO_3)3SiO_2$	transp. crystals	Brazil.
Tephroite	Mn_2OSiO_2	massive	Franklin, N.J.
Pyrope	$(\frac{1}{2}(MgO,CaO,FeO,MnO)_3+\frac{1}{2}AlO_3)_23SiO_2$	crystals	Bohemia.
Colophonite	$(\frac{1}{2}R_3O+\frac{1}{2}RO_3)_23SiO_2$	crystals	Willsborough, N.Y.
Zircon	ZrO_2SiO_2	crystals	North Carolina.
Vesuvianite	$(\frac{3}{5}R_3O+\frac{2}{5}RO_3)3SiO_2$	crystals	Moldavia.
Allanite	$SiO_2,AlO_3,FeO,MnO,CeO,LaO,DdO,YO,2HO$	partially decomposed	Virginia.
Zoisite	$(\frac{1}{3}Ca_3O+\frac{2}{3}AlO_3)_23SiO_2$	massive	Conway, Mass.
Ilvaite	$(\frac{3}{5}R_3+\frac{2}{5}RO_3)3SiO_2$	massive	Hartz Mts.
Iolite	SiO_2,AlO_3,FeO,MgO	translucent	Finland.
Phlogopite	$(\frac{7}{11}R_3O+\frac{4}{11}RO_3)_23SiO_2$	micaceous	Montville, N.J.
Lepidolite	$SiO_2,AlO_3,FeO_3,LiO,KO,Fl$	micaceous	Paris, Maine.
Nephelite	$(\frac{1}{4}R_3O,+\frac{3}{4}AlO_2)_23SiO_2+\frac{3}{4}SiO_2$	mixed with biotite	Vesuvius.
Lapis lazuli	SiO_2,AlO_3,CaO,NaO,S	massive	Brazil.
Leucite	$KOSiO_2+AlO_33SiO_2$	crystals	Vesuvius.
Anorthite	$(\frac{1}{4}R_3O+\frac{3}{4}AlO_3)_23SiO_2$	massive	Tunaberg, Sweden.
Oligoclase	$(\frac{1}{4}(NaO,CaO)_3+\frac{3}{4}AlO_3)_23SiO_2+3\frac{3}{4}SiO_2$	massive	Chester Co., Pa.
Andalusite	AlO_3SiO_2	crystals	Bavaria.
Fibrolite	AlO_3SiO_2	crystalline	Wilmington, Del.
Topaz	AlO_3SiO_2	crystals	Brazil.
Titanite	$(CaO+TiO_2)SiO_2$	crystals	Diana, N.Y.
Staurolite	$(\frac{1}{5}R_3O+\frac{4}{5}AlO_3)_43SiO_2$	crystals	Franconia, N.H.

III. SILICATES (*Continued*).

Mineral.	Formula.	Description.	Locality.
Laumontite	SiO_2,AlO_3,CaO,HO	crystals	Peter's Point, N.S.
Thomsonite	$2SiO_2,AlO_3,(\frac{3}{4}CaO+\frac{1}{4}NaO),2\frac{1}{2}HO$	crystalline	Renfrewshire, Scotland.
Mesolite	$3SiO_2,AlO_3(\frac{2}{3}CaO+\frac{1}{3}NaO)+3HO$	crystalline	Peter's Point, N.S.
Herschelite	$SiO_2,AlO_3,CaO,NaO,KO,HO$	——	Cyclops, Catania.
Heulandite	$6SiO_2,AlO_3,CaO,5HO$	red, crystalline	Fassathal, Tyrol.
Bowenite	$2MgOSiO_2+MgO2HO$	amorphous	Smithfield, R.I.
Bastite	——	massive	Germany.
Genthite	$(\frac{2}{3}(NiO_2,MgO)+\frac{1}{3}HO)_2SiO_2+\frac{4}{3}HO$	amorphous	North Carolina.
Kaolin	$AlSiO_2+2HO$	pulverulent	Rossville, Staten Island.
Gieseckite	$SiO_2,AlO_3,FeO_3,MgO,CaO,NaO,HO$	massive	St. Lawrence Co., N.Y.
Jefferisite	$(\frac{2}{5}R_3O+\frac{3}{5}RO_3)_2+3SiO_2+3HO$	micaceous	West Chester, Pa.
Prochlorite	$(\frac{4}{7}(MgOFeO)_3+\frac{3}{7}AlO_3)SiO_2+\frac{4}{5}HO$	crystalline	New Bedford, Mass.
Masonite	$(\frac{1}{4}(FeMgO)_3+\frac{3}{4}AlO_3)_43SiO_2+3HO$	massive	Natic, R.I.

IV. SUNDRY MINERALS.

Mineral.	Formula.	Description.	Locality.
Atacamite	$3CuOHO+CuClHO$	granular	Chili.
Columbite	$(FeOMnO)(CbO_5TaO_5)$	crystalline	Haddam, Conn.
Mimetite	$3PbOAsO_5+PbCl$	crystals	Bohemia.
Triphylite	$(FeOMnOLiO)_3PO_5$	massive	Grafton, N.H.
Triplite	R_3OPO_5+RFl	massive	Limoges, France.
Libethenite	Cu_4OPO_5+HO	crystalline	Cornwall, England.
Olivenite	$Cu_3O(AsO_5,PO_5)+CuOHO$	crystalline	Cornwall, England.
Pseudomalachite	Cu_6OPO_5+3HO	massive-granular	Copperopolis, Utah.
Wavellite	AlO_5,PO_5,HO	crystalline	Montgomery Co., Ark.
Pharmacosiderite	$3FeO_3AsO_5+FeO_33HO+12HO$	crystalline	Cornwall, England.
Torbernite	$U_2O_3PO_5+CuOHO+7HO$	crystals	Cornwall, England.
Autunite	$U_2O_3PO_5+CaOHO+7HO$	crystals	Autun, France.
Ulexite	SiO_2,BO_3,CaO,NaO,KO,HO	nodular fibrous	Nevada.
Cryptomorphite	BO_3,CaO,NaO,HO	chalky	Oregon.
Wolframite	$(FeOMnO)WO_3$	massive	Zinnwald, Bohemia.
Hübnerite	$MnOWO_3$	massive	Nye Co., Nev.
Scheelite	$CaOWO_3$	crystals	Zinnwald, Bohemia.
Wulfenite	$PbOMoO_3$	crystals	Mies, Carinthia.
Barite	$BaOSO_3$	massive	Pillar Point, N.Y.
Celestite	$SrOSO_3$	crystals	Strontian Is., L. Erie.
Anhydrite	$CaOSO_3$	crystals	Duremberg.
Crocoite	$PbOCrO_3$	crystalline	Hungary.
Brochantite	$CuOSO_3+2\frac{1}{2}CuOHO$	crystalline	Chili.
Mercury	Hg	liquid	———
Arsenic	As	massive	Germany.
Graphite	C	foliated	Ticonderoga, N.Y.
Aragonite	$CaOCO_2$	crystalline	N.Y.

ONE HUNDRED AND SIX SPECIES.

28. The minerals of the foregoing list were submitted to the action of the following reagents successively: (1) A solution of citric acid saturated at the temperature of the laboratory, say 65° to 70° F.; this we call simply "citric acid." (2.) The same solution to which solid sodium (or potassium) nitrate is added, which for convenience we shall call the "nitro-citric mixture." (3.) The same solution to which solid potassium iodide is added at the time of testing, and which for simplicity we shall designate as the "iodo-citric mixture."

The action of these reagents was studied in the simple manner detailed in our first paper. The mineral to be examined was carefully freed from its associated gangue and finely pulverised in an agate mortar; a portion was placed in a test-tube, the solution of the acid was added, and the resulting phenomena, in the cold, and on boiling carefully noted. In many instances the partial decomposition of the mineral was ascertained by filtering from the residue, and testing the solution with an appropriate reagent; or by examining the disengaged gas with a suitable test-paper.

Sulphides, Arsenides, &c.

29. Minerals of this group treated with citric acid alone, yielded results as follows:—

(*a*.) Clausthalite and leucopyrite dissolve in the cold without liberation of gas.

(*b*.) Alabandite is very strongly attacked in the cold with evolution of sulphuretted hydrogen. On applying heat it is wholly soluble. In this respect alabandite appears to be the most easily decomposed of all the sulphides yet examined, 37 in number.

(*c*.) Boulangerite, jamesonite, and kermesite are more or less attacked by boiling citric acid, yielding sulphuretted hydrogen. The remaining minerals of this group resist the action of cold or hot citric acid. Sulphur is absolutely unattacked even when the citric acid solution is heated to the melting-point of the element.

The powerful solvent action of a mixture of citric acid and sodium nitrate was discussed in our first paper (19), here we need only add that the intensity of action claimed for it is fully maintained by later researches.

(*d*.) All the minerals of the first group, 25 in number, with three exceptions, dissolve in the nitro-citric mixture rapidly and completely, several of them yielding solutions of characteristic colour. Even sulphur itself is decidedly attacked, with formation of sulphuric acid. The exceptions are realgar, orpiment, and proustite.

(*e*.) Two of these, realgar and orpiment, are partially decomposed by boiling with the iodo-citric mixture. Proustite and sulphur resist even on prolonged heating. All the remaining minerals of this group are quite readily dissolved, the decomposition of the sulphides being accompanied by liberation of sulphuretted hydrogen.

The differentiating power of these solvents is again exhibited by these reactions. In our first paper we showed that while bornite and pyrrhotite are decomposed by citric acid, their kindred compounds, chalcopyrite and pyrite, are not (13). We now find that proustite resists completely the decomposing solutions named, while pyrargyrite is decidedly attacked by the nitro-citric mixture as well as by the iodo-citric mixture, even in the cold.

This difference in behaviour of the two closely allied minerals was established by numerous determinations.

Oxides.

30. The oxides examined include such stable minerals as corundum, spinel, chrysoberyl, cassiterite, rutile, hyalite, and quartz, which naturally resist these methods of attack.

Gummite is attacked by cold citric acid, and melaconite and goethite are soluble to a certain extent on heating. Menaccanite and washingtonite are feebly attacked by the nitro-citric mixture and strongly by the iodo-citric solution. This latter also strongly attacks braunite and goethite.

Silicates.

31. Silicates are very unequally attacked by citric acid as well as by mineral acids.

(*a*.) Nephelite, lapis lazuli, laumontite, herschelite, thomsonite, mesolite, and prochlorite, are decomposed by citric acid in the cold, a portion of them with formation of a jelly.

Tephroite, ilvaite, gieseckite, jefferisite, heulandite, and genthite, are strongly attacked on boiling with the citric acid alone. Pargasite, pyrope, almandite, colophonite, phlogopite, bastite, masonite, and allanite (?), are feebly attacked. Some doubt obtains, however, as to the last named, because the specimens examined were partially decomposed on the surface.

(*b*.) The addition of sodium nitrate to the solution of citric acid does not notably increase its solvent power as respects silicates, but the addition of potassium iodide aids decidedly in effecting their decomposition. The iodo-citric mixture strongly attacks the garnets named, as well as enstatite, hypersthene, pargasite, epidote, and those named in paragraph 32.

The felspars resist these reagents, yet orthoclase and labradorite give up iron to them. Petalite, actinolite, asbestus, beryl, zircon, vesuvianite, zoisite, iolite, lepidolite, leucite, andalusite, fibrolite, topaz, titanite, staurolite, and kaolin, either wholly resist or give to the attacking solution only a trace of iron.

The variety of serpentine known as bowenite resists citric acid, while serpentine itself, of a normal character, is decomposed.

On the whole, citric acid attacks the silicates with a power nearly approaching that of hydrochloric acid.

Revision of the Silicates.

32. While carrying on these researches we were continually compelled to combat the firmly grounded impression that the organic acids are weak as respects mineral species. In consequence of this pre-conceived notion, we overlooked in our first paper the fact, that the decomposition of many silicates takes place at ordinary temperatures, having in fact applied heat at once when conducting the examination.

A closer investigation, however, shows that a saturated solution of citric acid is able to decompose many silicates in the cold, even to the formation of gelatinous silica. This necessitated a revision of the silicates named in our first paper (16), with the following results:—

(*a*.) Willemite, pectolite, calamine, natrolite, wollastonite, chrysolite, chondrodite, chrysocolla, apophyllite, rhodonite, analcite, chabazite, stilbite, and deweylite, are more or less strongly attacked by cold citric acid,—the first four yielding a jelly.

Datolite, prehnite, serpentine, chrysotile, and retinalite, are attacked on boiling the solution.

(*b*.) The use of the iodo-citric solution as a solvent having been discovered subsequent to the examination of the silicates named in our first paper, a further revision of this group became necessary. The results are briefly as follows:—

Olivine, augite, almandite, and epidote, heated with the iodo-citric mixture, are strongly attacked. Orthoclase, labradorite, hornblende, and spodumene, are very feebly attacked, or yield only iron to the solution.

Wernerite, albite, diopside, kyanite, talc, muscovite, biotite, ripidolite, and tourmaline, are not attacked.

These changes do not invalidate the accuracy of our published results, and are introduced simply to explain the change in position of these minerals in the Tables at the close of this paper.

(To be continued.)

SOLUTION OF BROMINE AS A REAGENT.

By L. L. DE KONINCK.

Bromine is more and more employed as an analytical reagent. Used alone it is not convenient, and a solution in water or in hydrochloric acid has been recommended. The former has the defect of being very dilute; the hydrochloric solution is much more concentrated but strongly acid. For three years the author has successfully used the solution of bromine in a 10 per cent solution of potassium bromide. The author recommends it for the precipitation of manganese from an acetic solution, for the conversion of arsenious into arsenic acid, and for the detection of nickel in presence of cobalt in a potassium cyanide solution.—*Zeitschrift für Analytische Chemie.*

NOTICES OF BOOKS.

A Popular History of Science. By R. Routledge, B.Sc F.G.S. London: G. Routledge and Sons.

The work before us can be fairly judged only on the conditions which the author has imposed upon himself. He has not undertaken the serious task of producing a history of science to serve as a book of reference for men of high attainments. He has not attempted to bring "into view those highly-generalised conceptions of modern thought with whose value and importance the expert is familiar." He has sought to furnish a book for popular use, and has accordingly introduced "simple illustrations of laws and principles, and ample details of experiments and observations" which a more learned class of readers would not require. The subjects treated of are astronomy, physics, chemistry, biology, and geology, and "to a certain small extent, mathematics." Psychology is not included. As a general rule Mr. Routledge observes the distinction between science and industrial art—so incomprehensible to the English national mind, and which even men of learning and high culture allow themselves to forget when they speak of noxious fumes and factory chimneys as "consequences of science." At times, however, the author loses sight of the boundary-line, as when he introduces accounts of the safety-lamp, the steam-engine, and the electric-telegraph.

In the earlier portions of the book the distinctions between the various branches of science are necessarily not observed. The author treats in successive chapters of ancient, Alexandrian, Arabian, and mediæval science. In the first of these sections he introduces accounts of Protagoras, Socrates, and Plato, whose claims to figure in a history of physical science are not unquestionable.

Full, but not exaggerated, honour is awarded to Roger Bacon. The fourth chapter is devoted to the science of the 16th century, the names of Copernicus, Tycho, Kepler, Gilbert, and Palissy, being the most prominent. The fifth chapter treats exclusively of Galileo, who persecutions and sufferings are described at length. The sixth section contains an account of the life and writings of Francis Bacon, of whose philosophy and its influence the author gives a very fair account, pointing out, however, the inconsistency of the "reformer of science," who could reject Copernicus and despise Gilbert. With the 17th century the sciences become differentiated, and we find mathematics, astronomy, physics, chemistry, and biology discussed henceforth in distinct chapters. To assign a fair proportion of so limited a space to each section of so vast a subject is, of course, a very difficult task. Perhaps it may be said that biology has scarcely fared as well at the author's hands as have the inorganic sciences. Thus, in the nineteenth century, physics receive 143 pages, whilst biology, at this epoch of evolution, is compressed into twelve.

The concluding remarks on the speculative aspects of modern science, on the conservation of energy and the dynamical view of the universe are deserving of warm commendation as a clear and luminous exposition. Within the boundaries which he has selected, Mr. Routledge may be pronounced a safe and judicious guide, and his work is admirably suited for well-educated young persons.

The illustrations are numerous, some, like the portrait of Faraday, characteristic and exceedingly appropriate; others of doubtful relevance.

CORRESPONDENCE.

COMMERCIAL ANALYSES.

To the Editor of the Chemical News.

Sir,—Mr. John Hughes has done good service in calling the attention of chemists to the discrepancies which arise in shoddy analyses owing to neglect of the loss of moisture which occurs in the preparation of samples for analysis. It is necessary, for a satisfactory nitrogen combustion, that the shoddy should be very finely cut up, and in a wet sample, as Mr. Hughes points out, the loss of water during this process is such as to cause a very serious error in analysis, unless it be estimated and taken into account. For a considerable time past it has been my own practice in analysis of damp shoddies to at once determine the water in the coarse sample as received and to dry the portion taken for analysis, so that the result when calculated out will give the true percentage of nitrogen and its ammonia equivalent in the sample as received. The same principle applies to other rough samples besides shoddy—raw phosphates for instance—and it is unfortunate that many analysts appear to pay no attention at all to the loss that takes place in grinding up such samples. A few days since, for example, I found that a sample of bone-ash, weighing but a few ounces, and containing in its coarse state as received about 12 per cent of moisture, lost during the process of grinding for analysis nearly 2 per cent of moisture, although the operation was performed as speedily as possible. The results were, of course, rendered on the original sample; but there are too many chemists who in such a case simply grind up the material and assume the fine portion to represent the original sample. An obvious injustice arises, seeing that commercial transactions in such materials are based altogether upon analytical results. It has during the last few years become the custom in most phosphate contracts to send the chemist a coarse sample for moisture only, and also a finely ground sample for analysis, the latter analysis being stated in the certificate, and a correction made to show the diminished percentage of phosphate which would accordingly be contained in the accompanying wet coarse sample. The analyst should work on precisely the same principle when he gets but the one coarse sample, otherwise his moisture —which is too often not determined at all—is too low and his phosphate too high. This precaution is particularly necessary in the case of bone-ash samples and similarly porous materials, which are capable of absorbing a good deal of water without appearing particularly damp, and which at the same time rapidly lose moisture during grinding in a mortar.

Perhaps such common-sense matters ought not to need ventilation in the pages of a scientific periodical; but trivial as they may be in one sense, they are of very serious importance to merchants, brokers, and manufacturers, and by no means of least importance to the large body of chemists—both chemists in factories and chemists in public practice—who occupy a high position of moral responsibility, affecting not only their own reputation, but the pockets of their clients or their employers.

I would take this opportunity of suggesting that the Institute of Chemistry—which has been, one way and another, a good deal occupied with the consideration of what may be called "chemical ethics"—should devote an evening to discussing not only the above points, but also sundry others which are frequently cropping up in the experience of commercial chemists, and which lie at the root of not a few of the too frequently recurring discrepancies that reflect so unpleasantly on the skill and practice of those whose occupation is assumed to be one of science and accuracy, and not one of rough and ready empiricism, as one might suppose from an occasional glance at some certificates which find their way into commercial transactions.—I am, &c.,

Bernard Dyer, F.C.S., F.I.C.

Analytical Laboratory, 17, Great Tower St., E.C,
January 11, 1881.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, l'Académie des Sciences. No. 24, December 13, 1880.

Reclamation of Priority as Regards the Law of the Corresponding Temperatures of Ebullition. — U. Dühring.—On February 23 last M. P. de Mondesir presented to the Academy a memoir on the comparison among the tension-curves of saturated vapours, and proposed a law identical with one put forward by M. Dühring nearly two years ago.

On Radiophony.—E. Mercadier.—The author has succeeded in proving that radiophonic effects may be produced by sources whose luminous brightness is much more feeble than that of an ordinary gas-light, and even by invisible radiations which are merely thermic.

New and Economical Methods for Producing Intermittent Luminous Signals.—E. Mercadier.—The author has devised a lamp where oxygen can be suddenly liberated in the midst of the flame, and as suddenly shut off, thus producing an intermittent flash for lighthouses, optical telegraphy, &c.

Absorption-Spectrum of Ozone.—J. Chappuis.—The absorption-spectrum of oxygen ozonised by the electric spark, if observed by means of a spectroscope with one or two prisms, presents eleven dim but well-defined bands in the portion of the spectrum ordinarily visible. The author has drawn up a diagram of these bands and compared it with the maps of the telluric bands. He notices the correspondence of a band in the orange with Angströms ray α, the origin of which he thinks must be sought in some other substance than watery vapour. On Angström's plan of the atmospheric rays there is laid down between the rays D and α a band extending from 606 to 613, a part of which coincides with the broadest band due to ozone. Angström mentions also in the yellow, towards D, an absorption-band always visible in the spectrum of the clear sky, and which extends from 568 to 58·12, and which he designates as δ. In the same region is a band due to ozone, and occupying a position partly in common with this band δ. The relative stability of ozone at low pressures and temperatures, and its almost incessant production by electric discharges render it an important element in the upper regions of the atmosphere, where its blue colour certainly takes a share in the colouration of the sky.

Action of Hydrochloric Acid upon Metallic Chlorides.—A. Ditté.—The chlorides which are rendered more soluble by hydrochloric acid are divided into two groups; the one (*e.g.*, mercuric chloride) exceedingly soluble in the concentrated acid form with it crystalline compounds; the other (*e.g.*, silver chloride) very sparingly soluble, even when heated, yield on cooling the chloride considered as anhydrous. The study of the chlorides which are precipitated from their solutions by hydrochloric acid will form the subject of a future communication.

Action of Hydrofluoric Acid upon Ammonium Bichromate.—L. Varenne.—The author has obtained by this reaction well-defined crystals of the formula—

$$NH_4F,2CrO_3.$$

Chlorine Derivatives of Strychnine.—MM. Richet and Bouchardat.—The authors have isolated in a state of purity three distinct chlorine compounds which preserve in different degrees the chemical properties of strychnine, especially of fixing the elements of water under the action of alkalies, and furnishing compounds which approach the amides by their general properties.

The Cause of Spontaneous Decomposition of Raw Cane-Sugar.—U. Gayon.—Organisms contained in these sugars multiply and produce an inversive ferment.

No. 25, December 20, 1880.

This issue consists merely of the discourses delivered at the funeral of the eminent mathematician, M. Michel Chasles, the *doyen* of the Section of Geometry.

Biedermann's Central-Blatt für Agrikultur-Chemie, Heft 6, 1880.

This issue opens with a biographical notice of the late editor, Dr. Richard Biedermann.

Researches on the Influence of Vegetation and its Shade upon the Carbonic Acid of the Ground-Air.—Prof. E. Woolny.—During the warm season soil overshadowed by living plants contained considerably smaller quantities of carbonic acid than such as was left fallow or covered with dead vegetation. The soil under a cover of growing plants is the poorer in carbonic acid the denser the vegetation.

The Permeability of Moss Coverings and Forest Refuse for Rain-water.—Dr. W. Riegler.—The conditions are too various to permit any decisive result.

Most Suitable Application of Artificial Manures for Potatoes.—Prof. M. Märker.—Not suitable for abstraction.

Signification of Lime for the Animal Organism.—Dr. E. Voit and Dr. F. Tuczek.—Animals deprived of lime in their food displayed in their bones modifications characteristic of rachitis.

Digestibility and Nutritive Value of Acorns.—Dr. H. Weiske, G. Kennepohl, and B. Schulze.—Acorns on account of their poverty in albuminoid matter can only be added in small proportions to the food of cattle.

Methods of Removing the Bitterness of Lupins.—Dr. E. Wildt.—The most satisfactory process is lixiviation with dilute sulphuric or hydrochloric acid.

Contributions to the Cultivation of the Sugar-Beet.—L. Vilmarin.—Deep ploughing and close planting are recommended to increase the yield of sugar.

Loss of Dry Matter during the Ripening of Crops.—MM. Marié Davy, A. Lévy, J. Roulff, and P. Dehérain.—During ripening there is often a considerable loss both of the nitrogenous and mineral constituents. It is not known whether this loss is necessary, nor if it can be avoided.

Researchea on the Growth of Leguminous Plants.—Dr. R. Pott.—Not adapted for abstraction.

Determination of the Proportion of Albuminoid Matter in Hay, &c.—Dr. H. P. Armsby.—The methods of Church (4 per cent solution of carbolic acid), Sestini (lead acetate), and Ritthausen (copper sulphate) give practically the same results as extraction with water.

The Albuminoids of Oil-seeds.—H. Ritthausen.—Albuminoid bodies containing more than 18 per cent of nitrogen, and closely resembling the conglutin of lupins and almonds are widely present in oil-seeds. Small quantities of nitrogen are present in non-albuminous compounds.

Connection of the Specific Gravity of Potatoes with their Proportion of Starch and of Dry Matter, and the Determination of Starch in Potatoes.—Prof. B. Tollens and Dr. J. Moritz.—The method described is pronounced inaccurate, admitting errors of from 1 to 2 per cent on either side of the correct quantity.

Chemical Change of Starch on Exposure to Steam at a High Pressure.—Dr. M. Stumpf.—A heat of 140° to 150°, and consequent pressure of 3½ to 4½ atmospheres convert 71 per cent of starch into glucose. The author considers that with the aid of 1 to 2 parts of acid per thousand saccharification may be carried so far as to render the use of malt unnecessary.

Contributions to the History of Starch and its Transmutations.—H. T. Brown and J. Heron.—From the *Annalen der Chemie.*

Experiments on the Production of Sugar from the Stems of Maize and Sorghum.—Prof. P. Collier.—The results are given in the form of tables.

Influence of Gypsum in the Manufacture of Sugar.—Dr. A. v. Wachtel.—The author found impurities of potassium and sodium sulphate in sugars prepared with gypsiferous water.

New Studies on the Part Played by Bone-black in the Sugar Manufacture.—H. Pellet.—Free lime is almost entirely absorbed by bone-black. Salts of lime and potash are also absorbed to a certain extent. Potash and lime, the latter in saline form, promote each others' absorption.

Action of Caustic Lime upon Pure Solutions of Sugar and Raw Beet-juice.—F. Desor.—If free alkalies or alkaline earths are added to a solution of sugar the rotation which sugar occasions in polarised light decreases, and is restored on neutralising the alkaline liquid with acetic acid.

Determination of the Absolute Quantity of Juice and of the Chemical Constituents of the Sugar Beet.—A. Gawalowski.—An extension of Grouven-Stammer's method.

The Analysis of Milk.—E. Marchand.—The author considers that in determining the total solids of milk the heat should not exceed 98° to 100°. He rejects the determination of fat by drying up with pumice, sand, &c., and extraction with ether. He prefers to mix the milk with twice its volume of a solution of equal parts water and glacial acetic acid, which completely dissolves the caseine. The fat globules are filtered off, and dissolved out of the filter with ether. Or he renders the milk alkaline, agitates with ether, and obtains the fat by distilling the ethereal solution.

Influence of the Method of Sampling Milk.—C. Weikowitsch and Dr. v. Klenze.—The authors consider it necessary to stir up a bowl of milk thoroughly immediately before taking the sample. An inverted beaker is then plunged into the milk up to its middle, inverted, and immediately drawn out in an upright position.

Sophistications of Commercial Melted Butter.—Dr. E. Meissl.—The butter in question is such as has been melted before sale. The author proceeds on Reichert's method, which he has somewhat modified.

A Section on Fermentation, Putrefaction, and Decay contains papers on the chemical changes of potatoes on freezing and putrefying, by H. Czubata; a memoir by Dr. Heinzelmann, on grain used in the manufacture of cake-yeast; an account of experiments with different kinds of yeast in mashing treacle for distillation, by A. Riche; and a note by E. C. Hansen on the influence of ventilation on the fermentation of worts.

Reimann's Färber Zeitung,

No. 31, 1880.

This number is largely taken up with the Leipzig Exhibition, and with a criticism of the new railway regulations concerning the transit of chemicals.

No. 32, 1880.

Artificial Indigo.—Prof. Baeyer has discovered a new blue colouring matter of the indigo-group. It is obtained by the prolonged contact of nitro-cinnamic and sulphuric acids.

No. 33, 1880.

Salicylic Acid in Textile Manufactures.—Dr. F. von Heydon recommends salicylic acid to be applied in dilute solution to woollen yarns, and to be mixed with sizes to prevent mildew, unpleasant smells, &c. Five grms. acid are sufficient for a litre of size.

Solution of Starch.—Zulkowsky proposes to make starch perfectly soluble in water by heating it to 190° C. along with glycerine. This process is most successful with potato-starch, less so with wheat-starch, and very difficult with rice-starch.

No. 34, 1880.

Electric Light in Manufacturing Establishments.—The River Side spinning mills in Providence, New Jersey, are now lighted with 71 lamps on Edison's system, which dispense with 578 gas-burners. The gas-consumption used to cost 6½ dollars per hour, while the 71 electric lights do not cost quite 2½ dollars hourly. The annual saving amounts to 12,000 dollars. The Spindler Works at Köpenick use the Jablochkoff candles, which give a light tinged with violet.

No. 35, 1880.

New Colouring Matters.—A Frankfort firm have latterly introduced several new colours into the market. Among these are Imperial Green (Kaiser Grün), "Vat Blue W," "Marine Blue," and "Gensdarm Blue." The last mentioned colour is mixed with an equal weight of acetic acid at 7° B., and added to abundance of hot water, brought nearly up to the boiling with frequent stirring, filtered, and used as hot as possible. Wool is dyed without any mordant entering at 62° and raising gradually to 100°. An addition of more acetic acid gives a greener shade, which may be pushed still further by the addition of Imperial Green. The admixture of Marine Blue R give redder tones. If carefully dyed this colour does not smear off. "New Marine Blue" is dissolved in the same manner. Wool is entered in the cold, heated gradually to 100° and requires no mordant. If bluer tones are required more acetic acid or Gensdarm Blue is added. "New Grey" is also used without mordant, raising the beck from 60° to 75°. It is modulated to a blue with acetic acid, to a red with cerise, and to a yellow with "mode." It is expected that chryso-toluidin (phosphine) will be entirely superseded by chrysoidine.

No. 36, 1880.

This number contains nothing of general interest.

MISCELLANEOUS.

Society of Arts.—A paper on "A New Mechanical Furnace, and a Continuous System of Manufacturing Sulphate of Soda" is announced for reading before this Society on Thursday evening, the 27th inst., by Mr. James Mactear, F.C.S., of Glasgow.

Presentation to Mr. Norman Tate, F.C.S., F.I.C.—We learn with great pleasure that on the 7th inst., a tea and coffee service of solid silver was presented to the above gentleman in recognition of his long and able services as a teacher of science in Liverpool. The presentation took place in the Town Hall, and was performed by the Mayor. Among the subscribers to the testimonial are included the three members for the city, many of the Aldermen, leading merchants, manufacturers, and professional men. Mr. Tate in returning thanks, referred to the gratifying fact that whereas the attendance at the Liverpool Science Classes had been at first only 20, the entries had this year reached 770.

The Reducing Agent in Urine containing Benzoic Acid.—E. Salkowski.—The reducing substance is an acid which has not yet been obtained in a crystalline condition.—*Z. f. Phys. Chem.*, 4, 135.

MEETINGS FOR THE WEEK.

MONDAY, 24th.—London Institution, 5.
— Medical, 8.30.

TUESDAY, 25th.—Civil Engineers, 8.
— Medical and Chirurgical, 8.30.
— Royal Institution, 3 p.m. "The Blood," Prof. Schäfer.

WEDNESDAY, 26th.—Society of Arts, 8. "Suggestions for Preventing London Smoke," W. D. Scott-Moncrieff.

THURSDAY, 27th.—London Institution, 7.
— Royal, 4.30.
— Royal Society Club, 6.30.
— Society of Arts, 8. "A New Mechanical Furnace, and a Continuous System of Manufacturing Sulphate of Soda," James Mactear, F.C.S.
— Royal Institution, 3. "The Troubadours,," Mr. F. Hueffer.

FRIDAY, 28th.—Royal Institution, 8. "Modern Spectroscopy," Dr. Schuster, 9.
— Quekett, 8.

SATURDAY, 29th.—Royal Institution, 3. "The Amazons," Prof. S. Colvin.

TO CORRESPONDENTS.

E. H.—We only know of a very small one by Feller, in two volumes, published by Trübner.

SPECIALITIES.

MANGANESE—Finest Crystallised, Lump, Ground, and Granulated of every quality, and PREPARED for *Chlorine, Glass, Steel, Ferro-Manganese Pottery, Battery*, and EVERY PURPOSE.

BAUXITE—(Hydrate of Alumina) Of high percentage of Alumina and almost free from Iron. The CHEAPEST, BEST, and MOST PROFITABLE article from which to produce ALUM, ALUM CAKE, and SULPHATE OF ALUMINA, &c. [BRAND, "IRISH HILL BAUXITE."]

FLUOR-SPAR—Of the Very Finest Quality for Acid, Soda, Glass Flux, and all purposes.

BARYTES—(Carbonate and Sulphate.) Crystallised, Selected Lump and Ground for all uses.

CRYOLITE—Magnesite, Felspar, Arsenic, Phosphates, French Chalk, Strontia, Wolfram, Chrome, Terra Alba, Rotten Stone, China Clay, Umbers Ochres, Antimony, Calamine, Emery Stone all Oxides, and all

FULLER'S EARTH—Of superior quality, and entirely free from grit. [BRAND, "EMERALD."]

MINERALS, CHEMICALS, AND COLOURS.

GEO. G. BLACKWELL,

MINE PROPRIETOR,

Manganese and Mineral Works, Grinding Mills, and Ore Yards, GARSTON.

OFFICES—26 CHAPEL STREET LIVERPOOL.

TETRACHLORIDE OF CARBON.
BISULPHIDE OF CARBON.
CHLORIDE OF SULPHUR.

JESSE FISHER & SON,
Phœnix Chemical Works Ironbridge.

ESTABLISHED 1798.

ROBERT DAGLISH & CO.,

ENGINEERS, BOILER AND BRIDGE MAKERS, MILLWRIGHTS,
BRASS AND IRON FOUNDERS.

Manufacturers of every description of Condensing, or High-pressure Blowing, Pumping, Rolling, Winding, and Patent Steam-engines, of any required power, for Irrigating, Draining, Mining, Rolling Mills, or Water Works purposes, and Manufacturers of every description of Chemical, Colliery, Copper Ore, Gold Mining, Glass, and Rock-salt Machinery.

Black-ash Revolving Furnaces of the Most Approved Type.

Bessemer Steel-Rail Plant.

Compressing-Engines for Collieries, Iron Works, and Weldon's Patent Bleaching-Powder Process.

Caustic, Chlorate, Decomposing, Nitre, Nitro-Glycerine, Iodine Potash, Sulphur, Acid, and Oxalic Pans.

Gas Producers Patent for Heating and other Purposes.

Pyrites Burners for Irish, Norwegian, and Spanish Ores of Improved Construction.

Patent Rousing Machinery for Brewers.

Retorts, Acid, Gas, Iodine, Nitric, Nitre, Nitro-Glycerine and Vitriol Refining.

Steam Superheaters improved for Oil, Tar, and Resin Refining.

Steam Sulphur Melter.

Stills for Oil, Resin, and Tar.

Wheels, Bevel, Mitre, and Spur Moulded on the Shortest Notice by Patent Machinery.

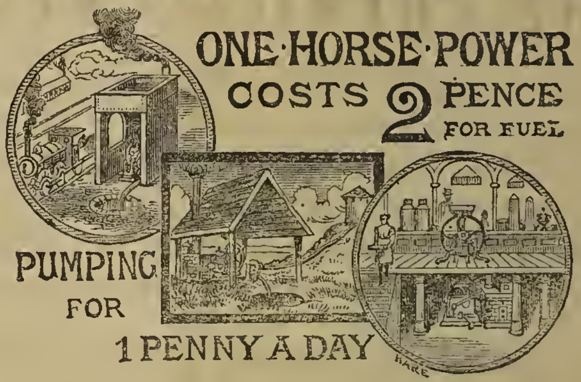
Makers of Mactear's Patent Carbonating Furnace, Jones and Walsh's Patent Sulphate of Soda Furnace, Parnell and Simpson's Patent Causticiser, and Kynaston's Patent Alum Plan

Lists sent on Application.

Photographs, Plans, and other information supplied on receipt of Order.

ST HELEN'S ENGINE, BOILER, AND BRIDGE WORKS AND FOUNDRY,
LANCASHIRE.

BAILEY'S PATENT HOT-AIR ENGINE.



Made from ½ to 5 horse-power. 56lbs. of coke will keep a 1-horse. going 12 hours. 1000 galls. of water lifted 50 feet high for a penny.

NO BOILER. NO DANGER.

Awarded Prize Medal by the chief Societies.

SOLE MAKERS—
W. H. BAILEY & Co., Albion Works, Salford, Manchester

BERNERS COLLEGE of CHEMISTRY.

Instruction and preparation in CHEMISTRY and the EXPERIMENTAL SCIENCES under the direction of Professor E. V. GARDNER, F.A.S., M.S.A.

The Class Rooms are open from 11 to 5 a.m. and from 7 to 10 p.m daily.

Especial facilities or persons preparing for Government and other examinations.

Private Pupils will find every convenience.

Analyses, Assays, and Practical Investigations connected with Patents, &c., conducted.

Prospectuses and full particulars on application to Prof Gardne at Berners College, 44, Berners-street W.

MR. J. S. MERRY,

ASSAYER AND ANALYTICAL CHEMIST,
SWANSE

ROYAL POLYTECHNIC.—Utopia, a Grand Fairy romance. The Electrical Railway; Great Lightning Inductorium; a Lecture on Scientific Wonders, by Mr. J. L. King. Musical Sketches, by Mr. Eric Lewis. Christmas and its Customs, by Mr. Frank Heath. Humorous Recitals, by Madame Hickson, Blondin, Leotard, Diving Bell, &c. Admission to the whole, 1s. Open from 11 till 5, and from 6 till 10.

BISULPHITE OF LIME.
BISULPHITE OF SODA.
SULPHITE OF SODA. TANNATE OF SODA.

WILLIAM MARRIOTT
CHEMICAL WORKS, HUDDERSFIELD

Silicates of Soda and Potash in the state of Soluble Glass, or in CONCENTRATED SOLUTION of first quality, suited for the Manufacture of Soap and other purposes, supplied on best terms by W GOSSAGE and Sons, Soap Works, Widnes, Lancashire.

London Agents, COSTE and Co., 19 and 20, Water Lane, Tower Street, E.C., who hold stock ready for delivery

---

THE CHEMICAL NEWS

AND

JOURNAL OF PHYSICAL SCIENCE.

Edited by WILLIAM CROOKES, F.R.S.

Published every Friday. Price 4d. Annual Subscription, post free, including Indices, £1

CHARGES FOR ADVERTISEMENTS.

	£	s.	d.
Five lines in column (about 10 words to line)	0	3	6
Each additional line	0	0	6
Whole column	1	15	0
Whole page	3	0	0

A reduction made for a series of insertions.

Cheques and Post-Office Orders, crossed "London and County Bank," payable to the order of William Crookes.

THE CHEMICAL NEWS.

Vol. XLIII. No. 1105.

ON THE

ULTIMATE ANALYSIS OF ORGANIC SALTS OF THE ALKALIES AND ALKALINE EARTHS.

By H. SCHWARTZ and P. PASTROVICH.

The ultimate analysis of organic salts of the alkalies and alkaline earths is now generally performed by means of chromate of lead, which is more costly than copper oxide, as it cannot be regenerated, and as it admits of only one use of a combustion-tube. It has been proposed to add pure fused potassium dichromate to the substance in the boat, and placing granulated copper oxide before it. Accurate determinations of carbon have been obtained in this manner, but a simultaneous estimation of the mineral constituent has to be dispensed with. If, however, as is now very general, the combustion is performed in a current of oxygen, the following method appears useful:—We prepare pure mercury chromate by precipitating pure neutral potassium chromate with mercurous nitrate, and washing by decantation. It is dried and ignited in a porcelain capsule, leaving pure finely-divided chromic oxide. An excess of this is thoroughly mixed with the weighed organic salt, and placed in a platinum or porcelain boat, not too small. The combustion-tube is open at both ends, and filled for two-thirds of its length with granular copper oxide, and ignited in a current of dry air. The charged boat is then introduced at the back, and the combustion is completed in the well-known manner. Pure dry oxygen is finally passed through for a sufficient time, whereby the carbonates of the alkalies and alkaline earths are entirely converted into neutral chromates, and the whole of the carbonic acid is obtained. Even nitrogenous substances may thus be burnt without danger of the formation of nitrogen oxides if the current of oxygen is kept moderate at the outset, so that the metallic copper placed in front may remain unoxidised till the last. If the boat is carefully drawn out when cold the base present in the salts may be accurately found by determining the chromates. In case of the soluble alkaline chromates this is performed most simply by means of a decinormal lead solution, which is run into the aqueous solution of the contents of the boat till a drop no longer gives a red precipitate with silver nitrate. In case of the chromates of the alkaline earths, it is more convenient to mix the contents of the boat with an excess of an acid solution of ferrous chloride of known strength, and to titrate the not-oxidised ferrous salt in the filtrate with permanganate.

In case of explosive nitro-products, such as potassium picrate, it is necessary to mix the substance first with chromic oxide, and then with an excess of copper oxide. The separation of the chromate formed from the copper oxide presents no difficulty. The same method may be adopted in the analysis of carbonates.—*Berichte der Deutschen Chemischen Gesellschaft.*

M. WIEDEMANN'S ELECTRIC PAPER.

Ordinary letter-paper, if well heated and briskly rubbed with the hand or with a brush, acquires electric properties; it adheres to tables, walls, &c., and on contact with the hand it gives slight electric discharges, visible in the dark. But on taking Swedish filter-paper, and submitting it to the treatment described below, its electric properties are greatly intensified, and sparks may be drawn from it several centimetres in length. The paper is steeped in a mixture of equal volumes of nitric and sulphuric acid, as in the manufacture of gun-cotton. The paper thus pyroxilised is washed with abundance of water and dried. If laid on a sheet of waxed paper and rubbed briskly it manifests energetic action, and may be used for the repetition of almost all experiments in static electricity.—*Comptes Rendus.*

ON THE

APPLICATION OF ORGANIC ACIDS TO THE EXAMINATION OF MINERALS.*

(Second Paper.)

By H. CARRINGTON BOLTON, Ph.D.

(Concluded from p. 34).

Sundry Minerals.

33. Under this head are grouped phosphates, arseniates, tungstates, sulphates, &c., as stated in the list given in 27.

A large number, chiefly phosphates, dissolve easily in a cold solution of citric acid; these embrace the following:—

Mimetite, triphylite, triplite, libethenite, olivenite, atacamite, pseudomalachite, wavellite, pharmacosiderite, torbernite, autunite, ulexite, cryptomorphite, and brochantite. Wulfenite and crocoite are strongly attacked on boiling, the latter yielding a green solution, owing to the reducing action of the organic acid on the chromic acid.

Columbite and wolframite are attacked by the iodo-citric mixture, at least so far as partially to dissolve the iron which forms one of their constituents.

Hübnerite is attacked by the nitro-citric mixture; while scheelite, barite, celestite, anhydrite, and graphite, resist completely these methods of attack.

Native Elements.—In our first paper we called attention to the solvent power of the nitro-citric mixture, as shown by the fact that it dissolves metallic copper, silver, lead, tin, bismuth, and antimony, besides iron, zinc, and magnesium (20); to this list we now add arsenicum and mercury.

Tabulation of Results.

34. In paragraph 22 we gave a table showing the behaviour of ninety minerals with citric acid and other reagents, arranged under eleven heads, viz.:—

A. Minerals which dissolve in cold citric acid without evolution of gas.
B. Minerals which dissolve in cold citric acid with liberation of carbonic anhydride.
C. Minerals which are decomposed by cold citric acid with evolution of sulphuretted hydrogen.
D. Minerals which dissolve in hot citric acid without evolution of gas.
E. Minerals which dissolve in hot citric acid with liberation of carbonic anhydride.
F. Minerals which are decomposed by hot citric acid with evolution of sulphuretted hydrogen.
G. Minerals which are decomposed by hot citric acid with formation of gelatinous silica.
H. Minerals which are decomposed by hot citric acid with separation of slimy silica.
I. Minerals decomposed by boiling with citric acid and sodium nitrate.
K. Minerals decomposed by heating with citric acid and ammonium fluoride.
L. Minerals which are not attacked by any of these methods.

To this we added, in a subsequent paper, a twelfth group, viz.:—

M. Minerals decomposed by heating with citric acid and potassium iodide.

---

* Read before the New York Academy of Sciences and the Chemical Section of the British Association, Swansea Meeting, 1880.

TABLES SHOWING THE BEHAVIOUR OF CERTAIN MINERALS WITH CITRIC ACID, ALONE AND WITH REAGENTS.

I.

Decomposed (in Fine Powder) by a Saturated Solution of Citric Acid.

1.—*In the Cold.*

A.
Without Evolution of Gas.

Clausthalite
Leucopyrite
Atacamite
Brucite
Gummite
Pyromorphite*
Mimetite
Triphylite
Triplite
Vivianite !
Libethenite !
Olivenite !
Pseudomalachite
Wavellite
Pharmacosiderite !
Torbernite
Autunite
Ulexite !
Cryptomorphite !
Anglesite
Brochantite !

B.
With Liberation of CO_2.

Calcite !
Dolomite*
Gurhofite !
Ankerite*
Rhodochrosite*
Smithsonite*
Aragonite !
Witherite !
Strontianite !
Barytocalcite !
Cerussite !
Malachite !
Azurite*

C.
With Liberation of H_2S.

Stibnite
Galenite
Alabandite
Sphalerite
Pyrrhotite

D.
With Separation of SiO_2.

Wollastonite
Rhodonite !
Chrysolite
Willemite !‡
Nephelite
Lapis lazuli
Chondrodite
Pectolite !‡
Laumontite !‡
Chrysocolla !
Calamine !‡
Apophyllite
Thomsonite !
Natrolite !‡
Mesolite !
Analcite
Chabazite
Herschelite‡
Stilbite
Deweylite
Prochlorite

2.—*On Boiling.*

E.
Without Evolution of Gas.

Cuprite !
Zincite
Melaconite
Goethite*
Limonite*
Allanite (?)
Apatite*
Wolframite*
Wulfenite
Crocoite
Gypsum

and those in A.

F.
With Liberation of CO_2.

Hausmannite†
Pyrolusite !†
Manganite†
Psilomelane !†
Wad !†
Magnesite !
Siderite !

and those in B.

G.
With Liberation of H_2S.

Bornite
Jamesonite*
Bournonite
Boulangerite
Kermesite

and those in C.

H.
With Separation of SiO_2.

Tephroite‡
Ilvaite
Phlogopite*
Datolite !‡
Prehnite*
Heulandite
Serpentine
Chrysotile
Retinalite
Bastite
Genthite
Gieseckite*
Jefferisite
Masonite*

and those in D.

II.

Decomposed by a Boiling Solution of Citric Acid, Mixed—

I.—With Sodium Nitrate.

Silver
Mercury
Copper
Arsenic
Antimony
Bismuth
Sulphur*
Bismuthinite
Domeykite !
Argentite
Hessite
Chalcocite !
Tiemannite !
Millerite !
Niccolite !
Pyrite !
Chalcopyrite !
Linnaeite
Smaltite !

Cobaltite !
Ullmannite !
Marcasite !
Arsenopyrite !
Nagyagite
Covellite !
Berthierite !
Pyrargyrite
Tetrahedrite !
Tennantite !
Stephanite
Polybasite !
Enargite !
Uraninite !
Hübernite

and those in C and G.

Realgar*
Orpiment*
Cinnabar !
Hematite*
Menaccanite*
Washingtonite*
Magnetite*
Franklinite
Braunite
Enstatite
Hypersthene
Augite
Spodumene*
Hornblende*
Actinolite*
Pargasite*
Olivine

K.—With Potassium Iodide.

Almandite
Pyrope
Colophonite
Epidote

and most of those in A, B, C, D, E, F, G, H, and I,

III.

Minerals not Decomposed by the above Reagents.

Graphite
Molybdenite
Proustite
Fluorite
Cryolite
Corundum
Diopside
Petallite
Asbestus
Beryl
Zircon
Vesuvianite
Zoisite
Iolite
Biotite
Muscovite
Lepidolite
Wernerite
Leucite
Andalusite
Fibrolite
Kyanite
Topaz
Titanite
Staurolite
Bowenite
Talc
Kaolin
Ripidolite
Columbite
Samarskite
Spinel
Chromite
Chrysoberyl
Cassiterite
Rutile
Quartz
Hyalite
Anorthite
Labradorite
Oligoclase
Albite
Orthoclase
Tourmaline
Scheelite
Barite
Celestite
Anhydrite

(Two hundred species.)

N.B.—The gases evolved are examined with acetate of lead test-paper, the solutions with appropriate reagents.

The kind and degree of action are indicated in the above Tables by the following signs:—! Completely decomposed or dissolved. * Feebly attacked. † The CO_2 evolved is derived from the citric acid. ‡ Gelatinises.

In the Tables accompanying this paper we have combined, on a similar plan, the results obtained in the present and previous communications, thus giving a comprehensive view of the behaviour of two hundred minerals with citric acid. The arrangement differs somewhat from the foregoing; we have re-adjusted the silicates to accord with facts stated in 32, and we have omitted the reaction with ammonium fluoride as of no importance in determining species.

To ascertain the exact position for each mineral has been no trivial task; and should errors be discovered, we crave indulgence, and beg our friends to remember the French saying: "Ceux qui ne se trompent jamais sont ceux qui ne font rien."

Summary.

35. The number of minerals examined, though considerable, if we regard the labour involved, is but small compared with those which remain to be treated by these methods, and any attempt at generalisation must be correspondingly weak.

It may, however, be admissible to study the Tables with a view to determining whether there is any relation, peculiar to the organic acid, between its solvent power and the chemical constitution of the minerals. This question may be considered from two standpoints, corresponding to two methods of classifying minerals, viz., with reference to their acidic and to their basic constituents.

(*a.*) The first method of grouping the minerals is the same as that of the list given (27); the question applied to them may be answered thus:—

All carbonates and phosphates are decomposed by citric acid.

The sulphides are very unequally attacked;—two resist the solvents, three yield only to the iodo-citric mixture, twenty-two only to the nitro-citric mixture, and ten are attacked by the acid alone. The oxides and anhydrous silicates are very unequally attacked.

The hydrous silicates are (with one or two exceptions) decomposed by citric acid alone.

(*b.*) An examination of the influence of the basic constituents on the solubility discloses the following points:—

All the copper minerals are soluble in one or more of the solvents.

All the manganese minerals are decomposed,—the sulphide and the silicates with great facility.

All the lead minerals are decomposed by citric acid alone. In some cases the presence of lead would seem to render a mineral easily broken up; this is marked in the case of the sulphides, which, as we have seen, are very unequally attacked; thus selenide of lead is attacked and selenide of mercury is not; sulphide of lead is attacked, while sulphide of silver is not. The minerals jamesonite, bournonite, and boulangerite (containing lead) are attacked, while the closely allied species stephanite, tennantite, polybasite, proustite, berthierite, &c. (devoid of lead) are not decomposed.

These facts may possibly point to a connection between chemical constitution and solubility, peculiar to the reagent employed; but we offer the suggestion with diffidence, owing to the limited number of facts on which to base generalisations. Moreover we find that the results obtained by the *prolonged* action of citric acid on minerals (ten to thirty days), differ greatly from those here recorded. To this we shall return at a subsequent period.

In conclusion, we beg leave to remind our readers that the immediate object in view, as was stated at length in our first paper, is the practical application of these methods to the examination of minerals in the field.

Trinity College, Hartford, Conn.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, January 20th, 1881.

Prof. H. E. Roscoe, President, in the Chair.

The following certificates were read for the first time:—F. N. Benjamin, J. J. Eastick, C. A. McMunn, W. G. McMillan, Tozokichi Takamatsu, P. Vieth.

The President then announced that the Faraday Lecture would be delivered by Prof. Helmholtz, on April 5, at the Royal Institution. The subject of the lecture would be "The Modern Development of Faraday's Conception of Electricity."

The President then called on Mr. Vivian Lewes to read a paper on "*Penta-thionic Acid.*" In March last the author, at the suggestion of Dr. Debus, undertook an investigation of penta-thionic acid, the existence of which has been denied. The analyses of the liquid obtained by Wackenroder and others, by passing sulphuretted hydrogen and sulphur dioxide through water, are based on the assumption that only one acid is present in the solution, and consequently do not establish the existence of penta-thionic acid; as, for example, a mixture of one molecule of $H_2S_4O_6$ and one molecule of $H_2S_6O_6$ would give the same analytical results as $H_2S_5O_6$. Moreover, no salt of penta-thionic acid has been prepared in a pure state. The author has succeeded in preparing barium penta-thionate thus:—A Wackenroder solution was about half-neutralised with barium hydrate, filtered, and the clear solution evaporated *in vacuo* over sulphuric acid. After eighteen days crystals, which proved to be barium penta-thionate + 3 molecules of water, formed. These crystals were separated, and the liquid further evaporated, when a second crop was obtained, intermediate in composition between the tetra- and penta-thionate. These were separated, and the mother-liquor on standing deposited some oblong rectangular crystals. These on analysis proved to consist of baric penta-thionate with three molecules of water. This salt dissolves readily in cold water; the solution is decomposed by strong potassic hydrate, baric sulphite, hyposulphites, and sulphur being formed. By a similar method of procedure the author obtained potassium penta-thionate, anhydrous and with 1 or 2 molecules of water. The author promises some further results with some other salts of the higher thionates.

The President said that the Society had to thank the author for a very complete research on the subject of penta-thionic acid. He, however, begged to differ from him as to his statements concerning the researches of Messrs. Takamatsu and Smith: in his opinion these authors had proved the existence of penta-thionic acid. He hoped that the crystals (which were very fine) would be measured.

Dr. Debus said that no one had previously been able to make the salts of penta-thionic acid, and expressed his sense of the great merit due to the author for his perseverance and success. The paper opened up some highly interesting theoretical speculations as to the existence of hexa-thionic acid. If potassium tetra-thionate was dissolved in water it could be re-crystallised, but potassium penta-thionate, under similar circumstances, splits into sulphur and tetra-thionate; but a mixture of tetra-thionate and penta-thionate can be re-crystallised. It seemed as if the sulphur when eliminated from the penta-thionate combined with the tetra-thionate.

Dr. Dupré asked Dr. Debus how it was that a molecule of penta-thionate could be re-crystallised, whereas two molecules of penta-thionate, which should when half-decomposed furnish a molecule of tetra- and a molecule of penta-thionate, could not.

Dr. Armstrong then read a "*Preliminary Note on some Hydrocarbons from Rosin Spirit.*" After giving an account of our knowledge of rosin spirit, the author decribed the result of the examination of the mixture of hydrocarbons remaining after heating it with sulphuric acid and diluting with half its volume of water and steam distilling. Thus treated rosin spirit furnishes about one-fourth of its volume of a colourless mobile liquid, which after long-continued fractional distillation is resolved into a variety of fractions boiling at temperatures from 95° to over 180°. Each of the fractions was treated with concentrated sulphuric acid, and the undissolved portions were then re-fractionated. The hydrocarbons dissolved by the acid were recovered by heating under pressure with hydrochloric acid. Besides a cymene and a toluene, which have already been shown to exist in rosin spirit, meta-xylene was found to be present. The hydrocarbons insoluble in sulphuric acid are, apparently, all members of the C_nH_{2n} series; they are not, however, true homologues of ethylene, but hexhydrides of hydrocarbons of the benzene series. Hexhydro-toluene and probably hexhydro-meta-xylelene are present besides the hydrocarbon $C_{10}H_2O$, but it is doubtful if an intermediate term is also present. It is by no means improbable, however, that these hydrocarbons are, at least in part, products of the action of the sulphuric acid. Cahours and Kraemer's and Godzki's observations on the higher fractions of crude wood spirit, in fact, furnish a precedent for this view. Referring to the results obtained by Anderson, Tilden, and Renard, the author suggests that rosin spirit perhaps contains hydrides intermediate in composition between those of the C_nH_{2n-6} and C_nH_{2n} series, also derived like the latter from hydrocarbons of the benzene series. Finally, Dr. Armstrong mentioned that the volatile portion of the distillate from the non-volatile product of the oxidation of oil of turpentine in moist air furnishes ordinary cymene when treated in the manner above described. The fact that rosin spirit yields a different cymene is, he considers, an argument against the view which has more than once been put forward, that rosin is directly derived from terpene. Probably resin and turpentine, though genetically related, are products of distinct processes.

The next paper was "*On the Determination of the Relative Weight of Single Molecules,*" by E. Vogel, of San Francisco. This paper, which was taken as read, consists of a lengthy theoretical disquisition, in which the author maintains the following propositions:—That the combining weights of all elements are one-third of their present values; the assumption that equal volumes of gases contain equal numbers of molecules does not hold good; that the present theory of valency is not supported by chemical facts and that its elimination would be no small gain for chemistry in freeing it of an element full of mystery, uncertainty, and complication; that the distinction between atoms and molecules will no longer be necessary; that the facts of specific heat do not lend any support to the theory of valency. The paper concludes as follows:—"The cause of chemical action is undoubtedly atmospheric pressure, which under ordinary conditions is equal to the weight of 76 cubic centimetres of mercury, one of which equals 6·145 mercury molecules, so that the whole pressure equals 467 mercury molecules. This force—which with regard to its chemical effect on molecules can be multiplied by means of heat—is amply sufficient to bring about the highest degree of molecular specific gravity by the reduction of the molecular volumes. To it all molecules are exposed and subjected unalterably, and if not accepted as the cause of chemical action, its influence has to be eliminated to allow the introduction and display of other forces."

The next communication was "*On the Synthetical Production of Ammonia by the Combination of Hydrogen and Nitrogen in Presence of Heated Spongy Platinum (Preliminary Notice),*" by G. S. Johnson. Some experiments, in which pure nitrogen was passed over heated copper containing occluded hydrogen, suggested to the author the possibility of the formation of ammonia: only minute traces were formed. On passing, however, a mixture of pure nitrogen (from ammonium nitrite) and hydrogen over spongy platinum at a low red heat, abundant evidence was obtained of the synthesis of ammonia. The gases were passed, before entering the tube containing the platinum, through a potash bulb containing Nessler reagent, which remained colourless. On the contrary, the gas issuing from the platinum rapidly turned Nessler reagent brown, and in a few minutes turned faintly acid litmus solution blue; the odour of NH_3 was also perceptible. In one experiment 0·0144 grm. of ammonia was formed in two hours and a half. The author promises further experiment as to the effect of temperature, rate of the gaseous current, and substitution of palladium for platinum. The author synthesised some ammonia before the Society with complete success.

The President referred to the synthesis of ammonia from its elements recently effected by Donkin, and remarked that apparently the ammonia was formed in much larger quantities by the process proposed by the author of the present paper.

Mr. Warington suggested that some HCl gas should be simultaneously passed with the nitrogen and hydrogen, and that the temperature of the spongy platinum should be kept just below the temperature at which NH_3 dissociates, in order to improve the yield of NH_3.

"*On the Oxidation of Organic Matter in Water,*" by A. Downes. The author considers that the mere presence of oxygen in contact with the organic matter has but little oxidising action unless lowly organisms, as bacteria, &c., be simultaneously present. Sunlight has apparently considerable effect in promoting the oxidation of organic matter. The author quotes the following experiment:—A sample of river-water was filtered through paper. It required per 10,000 parts, 0·236 oxygen as permanganate. A second portion was placed in a flask plugged with cotton-wool, and exposed to sunlight for a week; it then required 0·200. A third portion after a week, but excluded from light, required 0·231. A fourth was boiled for five minutes, plugged, and then exposed to sunlight for a week; required 0·198. In a second experiment with well-water a similar result was obtained; more organic matter was oxidised when the organisms had been killed by the addition of sulphuric acid than when the original water was allowed to stand for an equal length of time. The author also discusses the statement made by Dr. Frankland that these is less ground for assuming that the organised and living matter of sewage is oxidised in a flow of 12 miles of a river than for assuming that dead organic matter is oxidised in a similar flow.

"*Analyses of Queensland Soils*," by Prof. Liversidge. These analyses are of interest, as the soils include samples from localities which were exempt from the disease which was prevalent in the sugar plantations around. Analyses of the organic and mineral constituents of the surface and sub-soils are given.

"*On the Volumes of some Compounds of the Benzene, Naphthalene, Anthracene, and Phenanthrene Series*," by W. Ramsay. The author has determined the volume of a number of these substances in a perfectly pure state by the method given in *Chem. Soc. Jour.*, 1879, 473. The numbers are in every case smaller than those calculated. The mean of the differences in the benzene series is 3·92. The author has also determined the differences in the naphathalene and the anthracene series, and finds that there is a certain proportionality observable in the condensation of members of the benzene, naphthalene, and anthracene series.

"*On the Atomic Volume of Nitrogen*," by W. Ramsay. The author discusses the very slender grounds on which the accepted value of nitrogen in the amines (2·3) rests. From experiments with aniline, toluidine, dimethyl-aniline he concludes the value of nitrogen to be about 0·7, a number which is more probably true, for several reasons discussed by the author.

"*On a New Theory of the Conversion of Bar-iron into Steel by the Cementation Process*," by R. S. Marsden. The explanation of this phenomenon is to be found in the diffusion of carbon in an impalpable powder into the heated iron. It is analogous to the penetration of a red-hot porcelain crucible by carbon in an impalpable powder observed by the author (*Proc. Roy. Soc. Edin.*, x., 712), the carbon diffusing into the bars of iron while in an expanded and softened state. Silicon can apparently diffuse in a similar way through iron.

"*On the Action of Sulphyrate of Potassium on Chloral Hydrate (Preliminary Note)*," by W. W. J. Nicol. The chloral hydrate was obtained from Kahlbaum. Some freshly prepared sulphydrate of potassium was placed in a flask, and some chloral hydrate added. At first the crystals dissolved quietly, then gas was evolved, and the solution became more coloured, and a light yellow flocculent body separated. When this body appeared equal in bulk to the liquid, the fluid was filtered, and the residue washed, and dried *in vacuo*. Bisulphide of carbon extracted from it 35 per cent of sulphur. The residue gave on analysis the formula $C_3H_4S_2O_4$, which agrees very closely with that of a mixture of thio-glyoxylic acid and thio-formic acid in molecular proportions. A lead and barium salt were obtained, containing respectively 54·5 per cent Pb and 43·2 per cent Ba.

The Society then adjourned to February 3, when the following papers will be read:—"On the Estimation of Organic Carbon in Air," by A. Dupré and H. W. Hake. "On the Action of the Copper-zinc Couple upon Nitrates," by M. W. Williams.

PHYSICAL SOCIETY.

Saturday, January 22, 1881.

Prof. W. G. Adams in the Chair.

New member—Mr. G. Palgrave Simpson, B.Sc.

"*Notes on the Construction of the Photophone*," by Prof. Sylvanus Thompson were read by Prof. Reinold. Prof. Thompson was led by experiment to question whether Prof. Bell's form of photophone receiver was adapted to give the best results. Theoretically he finds with a given maximum of incident light distributed uniformly over the surface, the change of resistance in a selenium receiver will vary proportionally with its linear dimensions provided its parts be arranged so that on whatever scale constructed the normal resistance shall remain the same. A cell n times greater linearly each way will produce n times the variation in resistance for the same total amount of light. This follows from Prof. W. G. Adams's law that the change in the resistance of selenium is directly as the square root of the illuminating power. The author also finds that if the thickness of the conducting discs in the enlarged cell be kept the same as before, and their number increased n times, the change of resistance will be n^3 times as great as before. Selenium cells should therefore be as large as possible, and the light should be distributed over them uniformly, not focussed to a point. A conical mirror would therefore be better than a parabolic one to receive the beam. Such a reflector would be cheaper to construct, and there would be a minimum of loss by reflection, as the light would fall perpendicularly on a cylindrical cell parallel to its axis. To give the best effect its angular semi-aperture should be 45°, and this will bring the front end of the cell in the same plane as the mouth of the reflector. Prof. Thompson has also constructed an improved cell by winding parallel wires on a cylinder of slate grooved with a double-threaded screw, and filling the interval between them with selenium. This form gives superior effects to Prof. Bell's disc device.

Mr. Shellford Bidwell said that long annealing improved the sensitiveness of selenium for photophonic purposes. He got the best speech from cells of high total resistance made with fine wire. The selenium should, however, have a low specific resistance. With the apparatus he showed at a recent meeting of the Society he could now transmit articles from *Nature* and the *Nineteenth Century* so as to be heard every word by the listener.

Prof. Guthrie suggested that amorphous phosphorus should be tried in place of selenium, as a more permanent substance.

Mr. Glazebrook, of the Cavendish Laboratory, Cambridge, read a paper on the measurement of small resistances, and the comparison of the capacities of two condensers. In measuring small resistances by the Wheatstone balance, the results differed on varying the resistance in the battery wires. According to Prof. Chrystal this was due to a thermo-electric effect produced by the hand at the middle point of the divided platinum-iridium wire when the contact is made with it. It could be avoided by making this contact first and then making the battery contact. Mr. Glazebrook investigated the effect mathematically and experimentally. He suggested that the resistance in the battery wire should be kept small in comparison with the other resistances, and then the effect was inappreciable. It could also be eliminated by taking two measurements with reversed currents and calculating out. The author next considered the effect of a small leakage in comparing condensers by the Wheatstone balance method. He showed that the method was more sensitive when the resistances of galvanometer and divided coil were large.

Dr. J. Hopkinson stated that he had found a modification of this plan to be very promising. For the battery he uses an induction coil, and for the galvanometer a telephone. Thus a high electromotive force and sensibility was obtained.

PHILOSOPHICAL SOCIETY OF GLASGOW.

Chemical Section.

Monday, December 6, 1880.

Mr. Alexr. Whitelaw, F.C.S., Vice-Present in the Chair.

Four gentlemen were elected associates of the Section.

The Secretary read a letter from Prof. Willianson, University College, London, intimating his willingnes to adjudicate in the Graham Medal competition.

Dr. Wallace, President of the Philosophical Society, read a paper on "*The Chemistry of Sewage Precipitation,*" which will appear in our next issue.

NOTICES OF BOOKS.

Lehrbuch der Organischen Qualitativen Analyse. (Textbook of Organic Qualitative Analysis.) By Dr. C. T. Barfoed. Copenhagen: A. F. Höst and Son.

A complete manual of proximate organic analysis, both qualitative and quantitative, is as yet a desideratum in the literature of chemistry. Whether such a work can ever be produced as satisfactory as are certain treatises on inorganic analysis is, perhaps, open to question. Organic compounds are not merely excessively numerous, even if we restrict our attention to such as are of technical or pharmaceutical importance, but their characteristic reactions are liable to be modified or masked by the presence of foreign bodies to a greater extent than is known to be the case with the metals and their derivatives, necessitating of course modified processes for their recognition and determination. We need here merely mention as an instance that the detection of aconitine by means of extraction with alcohol becomes impracticable if oil is simultaneously present. Nevertheless, if absolute completeness cannot be reached, there is hope of very great progress in that direction, and we accept Prof. Barfoed's work as a most useful contribution. The first part only of this treatise is in our hands, which deals with the natural organic acids, and enters upon the amylaceous group.

Turning, as an example, to oxalic acid, we find that the author describes the free acid, and states its solubility in water, alcohol, and ether. He notices the general character of the oxalates, the behaviour of the acid when heated alone, with excess of concentrated sulphuric acid, with dilute sulphuric acid and manganese peroxide, when treated in the cold with strongly dilute sulphuric acid and a drop of potassium permanganate. He mentions the reaction of the free acid and of soluble oxalates with barium chloride, calcium chloride or acetate, calcium sulphate, lime water, and solutions of ferrous oxide. He points out how this last-mentioned reaction is affected by the presence of tartaric, and especially of citric acid. We are told that in presence of such and similar acids the detection of oxalic acid may be very satisfactorily effected by means of copper sulphate, with the addition of a small quantity of hydrochloric or nitric acid, and subsequent dilution with water. We find next an account of the behaviour of oxalic acid with lead acetate and silver nitrate, followed by instructions for the recognition of oxalic acid in its insoluble salts.

In a similar manner the author "works through" tartaric, citric, malic, tannic, gallic, pyrogallic, formic, acetic, succinic, benzoic, stearic, palmitic, oleic, butyric, lactic, uric, and hydrocyanic acids, and lastly the humic group. In each case very full instructions are given for the recognition of such acids in the presence of other acids, organic or inorganic. It will, of course, strike the reader that many acids have been omitted, but those which have been thus thoroughly and carefully dealt with are doubtless the most important and the most generally encountered.

In the few remaining pages of this part the author enters upon an account of the characteristic behaviour of "neutral organic bodies," beginning with cellulose, starch, and cane-sugar.

Two more parts are announced. We consider that this manual, when complete, will prove of great benefit to pharmacists, public analysts, and all chemists engaged with the investigation of organic bodies.

Demonstrations in Physiological and Pathological Chemistry, with a Concise Account of the Clinical Examination of Urine. By C. H. Ralfe, M.D. London: D. Bogue.

This work somewhat dis-commends itself to our sympathies from the fact that, like multitudes of other elementary works in all branches of science, it is avowedly examinational, and is arranged to "meet the requirements of those preparing for the examinations at the Universities of Oxford, Cambridge, and London." The idea of regulating study with reference to examinations seems to us a fundamental error. We are glad, however, to learn from the preface that a student can no longer pass in honours in physiology by dint of a good verbal memory. Says the author:—'He must prove that he has made observations for himself. He is expected to be able to prepare for microscopic examination the tissues and organs of the body, to test and separate the proximate principles and the chief products of decomposition, and to demonstrate the chemical composition and action of the secretions and the chief constituents of the tissues and nutritive fluids. In addition he is expected to make himself practically acquainted with the chief physiological instruments and the methods of employing them." This is undoubtedly no small step in the right direction.

The book contains in succession instructions for the demonstration of the saccharine and amylaceous principles, the fatty principles, the albuminous principles and their allies, the products of decomposition of the agents in and products of digestion, of the nutritive fluids, solid tissues, and the urine. Lastly, follow directions for the quantitative examination of some of the above-mentioned bodies and their constituents. A portion of the matter here given is surely needless, consisting as it does of instructions with which the student ought to be already familiar. We refer, for instance, to the figures of a chemical balance, of pipettes, burettes and their respective stands, and to the directions for weighing, &c. The characteristics of the various substances seem to us to be clearly given as far as the limited space will permit. The quantitative section is necessarily the least complete, the instructions given embracing only the determination of moisture, organic matter and salts, of uric acid in urine, of albumen in the same fluid, of lime, magnesia, potash, and soda, of free acid in urine, of urea, of alkaline and earthy phosphates, of phosphoric acid in combination with the earths, of chlorine, sulphuric acid, sugar, and iron. Probably, however, the instructions thus given are all which the plan of the book requires.

Report of the Chemical Examiner to the Government of India, May 4, 1880.

The official laboratory at Calcutta has been exceedingly active—313 toxicological cases, besides the examination of 603 alleged poisonous substances, and 116 articles supposed to be blood-stained, represent a great and exceedingly responsible body of work. It appears that the ordinary process for the detection of aconite fails in the presence of oily matters soluble in alcohol. In the toxicological cases the most frequent poison was opium, and next arsenic, followed after a wide interval by strychnia, morphia, mercury, and aconite. For the recognition of the last-mentioned poison the method of Stas is recommended. Of the supposed poisonous articles more than one-fourth contained arsenic, datura, aconite, opium, strychnine, and nux vomica seed being also feequent. There was one case of marking nut (*Semicarpus anacardium*). The Department is engaged with the examination of the indigenous vegetable poisons, beginning with the root of *Gloriosa superba*, a climbing liliaceous plant, common in Bengal. The active principle, superbine, is a resinous body, indifferent in its behaviour with reagents and narcotic-irritant in its action. The seeds of *Abrus præcatorius* and the bark of *Wrightea anti-dysenterica* are also under examination.

Inorganic Chemistry: adapted for Students in the Elementary Classes of the Science and Art Department. By Dr. W. B. Kemshead, F.R.A.S., F.G.S. London and Glasgow: W. Collins, Sons, and Co., Limited.

This little work is not without its suggestions. We learn from the title-page that the copy before us is one of the "twentieth thousand." If we remember what a multitude of elementary treatises on chemistry have made their appearance within the last dozen years, some of which enjoy large circulations, we cannot fail to conclude that a wonderful number of persons in these realms are studying chemistry to some extent and from some point of view. A further reflection is then near at hand: What is the result of all this study and of this preparing for examinations, elementary or advanced? Does our national share of original research increase in any ratio corresponding to the number of students? And if not, why not? Does the cause lie in some natural incapacity on our part, or in social arrangements which drive intellect away from the service of science to other fields of exertion?

Dr. Kemshead informs us that his book being specially written "for the use of pupils preparing for the first stage or elementary examination of the Science and Art Department, South Kensington, it necessarily confines itself to the subject prescribed in the syllabus of that examination. Seven only of the non-metallic elements are here dealt with—hydrogen, chlorine, oxygen, boron, carbon, nitrogen, and sulphur. The first six chapters of the book are devoted to elementary and general considerations, a prominent place being given to atomicity and to "graphic notation." These topics are necessarily introduced from the South Kensingtonian character of the work, as well as from the author's "proclivities." As regards the subject-matter it would be singular indeed if any error had crept in. The only statement to which we can fairly take exception is doubtless a clerical or typographical error. On page 183, namely, we read—"On this production of soda depend the two manufactures of *soda* and glass." We presume the author meant to say "of *soap* and of glass." In view of recent investigations it may perhaps be questioned whether boron is entitled to rank along with carbon, but its removal to a different situation would perhaps be a transgression against the "syllabus." The enormous sale of the book is sufficient proof of the reputation which it enjoys among teachers of chemistry.

Cassell's Cookery: Part I. London: Cassell, Petter, and Galpin.

Cookery is undoubtedly one of the chemical arts, and when practised rightly is based upon chemical principles, whether the operator acts in consciousness of this circumstance or is guided merely by a happy tact. The treatise before us opens wells by laying down some of these chemical principles, of which the English "plain" cook is serenely ignorant, or at least regardless. Some statements meet our eye, however, which to the man of science seem objectionable, however they may be regarded by the practical cook. Thus we find the remark anent frying-pans that "new tin is sometimes poisonous." So, alas, is old tin when it is largely alloyed with lead! We find a receipt for an abomination entitled "alum whey," into which a "teaspoonful of powdered alum, or more if preferred" is to be introduced! Alum is certainly not an article which ought ever to be taken internally, since, to say the least, it renders the phosphates which may be present in food insoluble, and causes them to be expelled from the system as waste. A receipt for "acorn coffee" might also have been judiciously omitted. We were not aware that any human being, except in the extremities of famine, would eat the berries of the mountain-ash, which are, if possible, even harsher than the cranberry. Yet it is here recommended as the material for a jelly! Black-puddings occupy a column without the needful caution as to their exceedingly unwholesome nature. Modern science pronounces that the blood of slaughtered animals finds its legitimate application, not in the kitchen, but in the manufactures of albumen for the calico-printer and of chemical manures. Even as a food for swine it ought to be interdicted.

A few verbal peculiarities may also be noted. "Vanille" is a French word for the English "vanilla." "Saleratus" is an Americanism for bicarbonate of soda—a substance which we venture to say should not be introduced into the system except under medical advice.

Regarded as a whole, we consider that this work will be useful, but we think that nothing condemned by modern chemical and physiological science should have been introduced.

Cassell's Popular Educator: Part I. London, Paris, and New York: Cassell, Petter, Galpin, and Co.

We are not surprised that a new edition of this work has been called for, and we do not doubt but that it will be well appreciated by the public. The part before us contains, however, no "lessons" in chemistry, physics, or in the arts to which they serve as a foundation, and consequently does not come under our cognisance.

CORRESPONDENCE.

NOTE ON THE ANALYSIS OF SHODDY- AND WOOL-WASTE.

To the Editor of the Chemical News.

Sir,—The remark of Mr. Hughes in the Chemical News, vol. xlii., p 325, assailing shoddy manufacturers as a body, I cannot refrain from replying to, as it would hardly be fair to leave buyers under the impression that they cannot buy this commodity on satisfactory terms, the sellers being, according to the focus of Mr. Hughes's ideas, more or less *black sheep*.

I think most of the buyers will recognise that Mr. Hughes's statements are very much overdrawn, the sampling, for instance, being now almost invariably done by the buyers themselves on receipt of the goods, and they will of course in their own interests see that samples are fairly taken. *If* chemists do not know their own work, they must surely feel obliged to Mr. Hughes for pointing out to them the loss of moisture during the operation of preparing for analysis. To me it seems that Mr. Hughes proposes to analyse a *partially* dried sample. Would it not be more reasonable to dry the sample altogether and reduce the percentage of nitrogen according to the moisture present?

The *average* of *good* shoddy according to our experience should at all events be not less than 10 per cent, as our A 1 shoddy contains about 14 per cent ammonia; and while wet shoddies, adding both in carriage and working up to the cost per unit, should be as much as possible excluded, still they may according to their composition contain the percentage of ammonia Mr. Hughes denies to them.

In conclusion the fairest way to sample is as we practise it, *i.e.* taking a handful or so promiscuously from *each* bag, and submit the mixed sample to the chemists.—I am, &c.,

Edwd. Massey.

The West Riding Shoddy Manure Co.,
Dewsbury.

BLEACHING-POWDER.

To the Editor of the Chemical News.

Sir,—Mr. Kingzett's letter in the Chemical News (vol. xliii., p. 25), evidently calls for a reply on my part, but I am unable to see of what he can complain, or how he can believe me to have forgotten his paper of May, 1875 (quoted in my "Treatise on Sulphuric Acid and Alkali," vol. iii., p. 90), because I say that most chemists assume calcium hypochlorite to exist in solutions of bleaching-powder. This opinion is not merely shared by Mr. Kingzett, but he believes he has established it with certainty by obtaining calcium hypochlorite in a crystallised state. Or should Mr. Kingzett demur to my statement that *most* chemists share his opinion on the ground that I ought to have said *all* chemists? In that case I must beg to differ from him. I, for one, although I think it very likely that $2CaOCl_2$ may at once split up in the presence of water into $Ca(OCl)_2+CaCl_2$, do not think this absolutely proven, in view of the experiments of Wolters, and at this moment a research on this subject is being pursued in my laboratory. I consider this matter all the more open to further investigation, as Mr. Kingzett in his own paper (Chemical News, vol. xxxii., p. 22) apologises for the very imperfect state of his observations; he points out that the evidence is not beyond every doubt and that his experiments should be repeated. Desirous of seeing clear in this matter, I have thrice tried preparing Mr. Kingzett's crystals, exactly as described by him from various samples of very strong bleach, but I have failed every time, and I am afraid that those crystals can only be obtained under certain conditions which are not pointed out by Mr. Kingzett; perhaps he was not aware of their importance and of their accidental presence in his case.

I also differ from Mr. Kingzett in not regarding his investigation as furnishing the strongest or any proof of the correctness of Odling's formula. The difference of that formula, Cl—Ca—OCl, from Balard's and Gay-Lussac's is precisely that the former does *not* assume $Ca(OCl)_2$ to pre-exist in dry bleaching-powder. For anyone who has read my book or even only my last paper on bleaching-powder, it is unnecessary to say I that adhere to Odling's formula, and that I do not think the fullest demonstration of the presence of $Ca(OCl)_2$ in *solutions* of bleach would disprove Odling's formula for *dry* bleach, although some chemists have actually quoted Mr. Kingzett's paper in such a sense. But how such a demonstration can be said to do the very reverse, viz., to *prove* the correctness of Olding's formula as against the older formula, which assumes $Ca(OC)_2$ to pre-exist in dry bleach, I am utterly anable to see, nor does Mr. Kingzett's paper contain any other *proof* of that correctness.—I am, &c.,

George Lunge.

The Polytechnic School, Zürich,
January 18, 1881.

BENZOL BOILING-POINTS.

To the Editor of the Chemical News.

Sir,—I have recently received a circular from a well-known manufacturer of thermometers, referring to thermometers used for this purpose, and in which the following statement occurs, viz., that "with commercial benzols, boiling or distilling at constant and uniform rates, different thermometers of admitted accuracy do not indicate the same quantity or percentage of fluid distilled. This result, which may give rise to serious inaccuracy in returning trade certificates, is due to two causes, firstly, that of inequality in the size of the bulbs of the instrument employed and quantity of contained mercury; and secondly, that of the length of the indicating column; in other words, two instruments differing by six inches in the length of the divisions marking 100° C., may occasion a variation of several per cent in the quantity of fluid distilled, although, as previously stated, passing over at a 'constant and uniform rate of speed.' A perceptible interval elapses in the time occupied by the mercury in traversing the respective distances or column, and which is sufficient to occasion the inaccuracy referred to."

Can it be true that to this circumstance is owing the very unpleasant discrepancies constantly occurring between parties engaged in the sale and purchase of commercial benzol? I should be glad to learn how far it is known to manufacturers and distillers in general, and thankful to any of my London friends willing to impart information in a question obviously of so much import.—I am, &c.,

A Country Tar Distiller.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, l'Académie des Sciences. No. 26, December 27, 1880.

Speed of the Propagation of Light.—A. Cornu.—A critique on the memoir of M. Gouy (*Comptes Rendus*, xci., p. 877), whose conclusions he holds to be inaccurate.

Hydrochlorates of the Metallic Chlorides, and the Reduction of Chlorides by Hydrogen.—M. Berthelot.—Combinations of the hydracids and the metallic salts derived from halogens are very general, and resemble the complex acids derived from the association of hydrocyanic acid with metallic cyanides.

An Oxygenous Base Derived from Alolol.—A. Wurtz.—Dialdane, on being heated to 100° for two days in presence of mercury, deposits a colourless resinous matter, which is represented by the formula $C_{16}H_{28}N_2O_3$. Its aqueous solution has the singular property of coagulating on ebullition, and depositing a precipitate which re-dissolves on cooling. By its composition, and by the bitterness of its solution, and of that of its hydrochlorate, it approximates to the natural oxygenous bases. Dialdane is an aldehyd, and it is not impossible that bodies of this class intervene in the natural synthesis of oxygenous bases.

A New Method of Producing Luminous Intermittent Signals.—A. Crova.—The author, in concert with Leverrier, devised, in 1870 and 1871, an apparatus for optical telegraphy, absolutely identical with that described by M. Mercadier, employing merely an oil-lamp in place of one burning petroleum.

A New Electro-dynamic Theorem.—G. Cabanellas.—If the axles of two electric machines whatsoever, theoretically free and reversible, are connected in an invariable relation of rotation, and if the one of these machines has, in a given time, conveyed in any order a definite total quantity of electricity, the other machine will have also in the same time served as the vehicle of a total quantity of electricity, likewise definite, and a function of the former.

Regulator for the Pressure of Vapours. — M. d'Arsonval.—An illustrated paper.

A New Derivative of Nitrogen Sulphide.—Eug. Demarçay.—Nitrogen sulphide exposed to the action of the yellow sulphur chloride forms various compounds, the existence of which has been pointed out by Fordos and Gélis. The author describes one of them, formed when the sulphur chloride is in large excess. Its composition is S_4N_3Cl. The radicle S_4N_3 is capable of playing the part of a base, or an alcohol radicle, and in its constitution it approaches the sulphines of M. Cahours. The derivatives which the author has studied he names thiotrithiazyl chloride, nitrate, and bisulphate.

A Platinous Hypophosphite.—R. Engel.—The author obtains this compound by the action of hydrogen phosphide upon platinum tetrachloride.

Sodium Boro-tungstates.—D. Klein.—The author has obtained a sodium boro-duodecimo-tungstate, which he has not succeeded in purifying perfectly. Chromic and iodic acids appear to form with the molybdic and tungstic acids complex compounds, true acids, analogous to that formed by the boric and tungstic acids.

Certain Facts Relating to the Transformation of Chloral into Meta-chloral.—H. Byasson.—The author thinks the transformation is due to the action of a trace of sulphuric acid, and may be prevented or at least retarded by the action of caustic baryta.

Oxidation-Products of Cholalic Acid.—P. T. Clève.—By the action of a permanganate along with sulphuric acid there was formed not a trace of fatty acids. Oxalic acid was produced, but not acetic acid. A crystalline acid was obtained of the composition $C_{50}H_{70}O_{17}+4H_2O$. The same compound was produced by the action of chromic acid.

Distribution of Light in the Solar Spectrum: Spectrum of the Colour-Blind.—J. Macé and W. Nicati.—In three of the cases of colour-blindness examined the perception of the red is exceedingly enfeebled. In the yellow their sight is almost normal, and in the green their perception is even better than that of the normal eye. In the fourth case, on the contrary, the perception of the red is more acute than in the normal eye; the yellow is distinguished fairly, whilst the perception of the green is weakened. The blue and green are seen normally. Among the colour-blind of the same class (not perceiving the red ray) there exist decided differences in the perception of the blue and the violet. The author's experiments prove the existence of two distinct species of colour-blindness, and they overturn the theory of colours of Hering. According to this writer two photochemic substances are concerned in vision, the one in the perception of red and green, and the other in that of blue and yellow, one member of each group acting by disassimilation and the other by assimilation. The facts observed agree with the Young-Helmholtz theory of colours. We may imagine in the retina three distinct photo-chemical substances, corresponding to the three fundamental colours, red, green, and violet.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin.

No. 6, 1880.

Determinations of the Vapour-Densities of the Semi-liquid Polymeres of Iso-butyl-aldehyd and some of its Products of Distillation.—F. Urech.—Not suitable for abstraction.

For Explanation.—V. Merz.—Referring to Herrn Geuther's paper (13, p. 323), the author points out that he, in conjunction with Tibriga, made known two and a half years ago that carbonic oxide is abundantly absorbed by heated soda- and potassa-lime, with the production of formic acid (*Berichte*, x., 2117).

Syntheses by Means of Malonic Ester.—M. Conrad and C. A. Bischoff.—The authors have prepared iso-propyl-malonic ester, iso-propyl-malonic acid, iso-propyl-acetic acid, ethyl-methyl-malonic ester, ethyl-methyl-malonic acid, ethyl-methyl-acetic acid, dioctyl-malonic ester, dioctyl-malonic acid, dioctyl-acetic acid, allyl-malonic ester, allyl-malonic acid, allyl-acetic acid, diallyl-malonic ester, diallyl-malonic acid, diallyl-acetic acid, benzyl-methyl-malonic ester, benzyl-methyl-malonic acid, benzyl-methyl-acetic acid, nitroso-malonic ester, nitroso-malonic acid and its potassium salt, nitroso-benzyl-malonic ester, mono-chlor-malonic ester, tartronic acid, mono-chlor-iso-butyl-malonic ester, &c.

Decomposition of Nitroso-sulph-hydantoine by Baryta, and on a New Acid, the Nitroso-thioglycolic.—R. Maly and R. Andreasch.—This paper does not admit of useful abstraction.

Relations between Hyoscyamine and Atropine, and Conversion of the one Alkaloid into the other.—A. Ladenburg.—The author has completed the conversion of hyoscyamine into atropine, and removed every doubt as to the identity of their products of decomposition. Perhaps they are to be regarded merely as physically isomeric.

Combinations of the Benzo-trichlorides with Phenols and Tertiary Aromatic Bases.—Oscar Dœbner.—An interesting paper, which does not admit of abstraction.

Action of Phosphonium Iodide upon Carbon Disulphide.—H. Jahn.—The author had overlooked that the same subject had been previously investigated by Prof. E. Drechsel.

Hydro-camphen.—J. Kachler and F. v. Spitzer.—The authors have succeeded in obtaining hydro-camphen by treating borneol chloride dissolved in benzol, with sodium. The results are camphen and hydro-camphen. The latter compound resists even strong oxidising agents.

Benzoylised Sulpho-amido-phenol-anilides.—Jul. Post and L. Holst.—The results of these researches are expressed in tables which cannot be usefully abridged.

Inversion of the Direction of Rotation of Ordinary Malic Acid by a mere Difference in Concentration.—G. H. Schneider.—Malic acid and its salts have hitherto been regarded as lævo-rotatory. In examining the free acid, the author observed that on taking more and more concentrated solutions the specific rotation first decreased, then disappeared, when the percentage of acid had reached about 34, and in still stronger solutions passed into an increasing dextro-rotation. Hence, if only a single solution of any given body is examined, the neutral point may be accidentally chosen, and the substance may be pronounced optically inactive.

Decomposition (so-called Catalysis) of Hydrogen Peroxide in Presence of Alkalies and Alkaline Earths.—E. Schœne.—The author considers M. Berthelot's theory on the decomposition of hydrogen peroxide in presence of alkalies incomplete, as it renders no account of the simultaneous decomposition of the double oxides.

Behaviour of Hygrogen Peroxide with Potassium Iodide.—E Schœne.—The author shows that in opposition to the statement of Berthelot the result is a violent disengagement of oxygen, a yellow colouration due to liberated iodine, and an alkaline reaction of the liquid (See *Comptes Rendus*, Feb. 23, 1880).

Ethereal Oil of Onodaphne Californica.—J. M. Stillman.—The oil consists of two compounds, terpinol and umbellol, $C_8H_{12}O$, the latter not previously known.

Derivatives of the Quinon from the Hydrocarbon $C_{16}H_{12}$. Polymeres of the Quinon.—A. Breuer and T. Zincke.—The authors examine the methylamine, ethylamine, aniline, toluidine, and naphthyl derivatives. They have also examined two polymeric forms of the quinone, which they distinguish as the white and the yellow.

Behaviour of Benzoyl- and Acetyl-Carbinol on Oxidation.—A. Breuer and T. Zincke.—The products of the oxidation of benzoyl-carbinol are benzoic, amygdalic, and benzoyl-formic acids. Acetyl-carbinol yielded lactic acid, and to a slight extent pyruvic acid.

A New Kind of Ammonium Compounds.—Peter Griess.—An account of trimethyl-nitro-phenol-ammonium, trimethyl-amido-phenol-ammonium, and ortho-trimethyl-anisol-ammonium.

Pinacones and Pinacolines.—W. Thörner and T. Zincke.—A description of aceto-phenon-pinacone and aceto-pinacone.

Behaviour of the Anhydrous Alkaline Earths with Sulphurous Anhydride.—K. Birnbaum and C. Wittich.—Pure anhydrous baryta begins to absorb sulphur dioxide at 200°; at 230° complete saturation was effected in about four weeks. The product was entirely soluble in hydrochloric acid, and contained not a trace of sulphate or sulphide. Strontia absorbs sulphurous anhydride less readily than does baryta. At 290° saturation is effected in six weeks, the product being neutral strontium sulphite. Lime absorbs the gas rapidly at 400°, and in two or three days is converted into pure sulphite. Magnesia absorbs sulphurous anhydride very slowly at 326°. The weight does not become constant until after three months.

The Homologues of Phosphenyl Chloride and the Mode of Action of Aluminium Chloride.—A. Michaelis and C. Panek.—The authors have obtained tolyl-phosphor-chloride and xylyl-phosphor-chloride. Aluminium chloride acts by combining with one portion of the nascent body.

The Constitution of Selenious Acid.—A. Michaelis and B. Landmann.—Selenious acid behaves as a true dihydroxylic acid, and quite differently from sulphurous acid.

Contributions to the Examination of Wine.—V. Wartha.

Occurrence of Vanilline in Raw Sugars.—E. O. von Lippmann.—The author demonstrates the presence of vanilline in certain crude beet-root sugars.

Diamido-triphenyl-methane.—Otto Fischer. — This base, $C_{19}H_{18}N_2$, is readily soluble in ether, alcohol, chloroform, and ligroin.

New Synthesis of Leucaniline.—Otto Fischer and P. Grieff.—Para-nitro-benzaldehyd is digested at 120° with aniline hydrochlorate and zinc chloride; the mass is dissolved at a boil in dilute sulphuric acid, filtered from the unchanged aldehyd, the filtrate mixed with strong soda lye and aniline if present; distilled off a yellow base is obtained, para-nitro-diamido-triphenyl-methan, which, if reduced with zinc powder and acetic acid, yields a leucobase, in every respect identical with para-leucaniline, and which on oxidation passes into magenta.

A Second Triamido-triphenyl-methane (Pseudoleucaniline).—Otto Fischer and Joseph Ziegler.—The body obtained differs from leucaniline merely by the position of one of the three amido groups.

Amido-triphenyl-methane.—Otto Fischer and L. Roser. The authors prepare this base by digesting benzhydrol and aniline hydrochlorate for fifteen to twenty hours with zinc chloride at about 150°. The product is treated with water in order to remove zinc chloride, mixed with dilute sulphuric acid, and the solid residue is freed from excess of benzhydrol and from by-products by means of ether.

A New Method of Preparing Meta-toluidine.—Oskar Widman.—The author adds in small portions five parts meta-nitro-benzaldehyd to nine parts of phosphorus penta-chloride, avoiding a great rise of temperature. When the reaction is over, the whole is poured into excess of cold water, quickly washed a few times with cold water, and dissolved in alcohol. After the first crystallisation the compound melts at 65°, and is perfectly pure.

Synthesis of Naphthyl-diphenyl-methane.—V. Hemilian.—The author has anticipated A. Lehne in the synthesis of this compound.

Ortho-hydrazin-benzoic Acid.—E. Fischer.—An account of the preparation and properties of this acid and its anhydride.

The Constitution of the Sulphur-ethanes.— C. Liebermann.—Not suitable for abstraction.

A Compound of Ether with Phosphorus Perchloride.—C. Liebermann and L. Landshoff.—This compound, which is formed by mere contact, is represented by the formula $P_3Cl_{15}C_8H_{14}O_2$.

Certain Derivative of Sulphanthraquinonic Acid.—D. A. McHoul.—A description of anthraquinon-sulphonchloride, anthraquinon-sulphamide, anthraquinon-sulphanilide, and anthraquinon-dimethyl-aniline-sulphone.

The Empirical Formula of Catechine.—C. Liebermann and M. Tauchert.—The analyses executed by the authors support the formula $C_{21}H_{20}O_9$, which approximates to that of Schützenberger and Rack.

Action of Chloro-carbonic Ethyl-ether upon the Phenols.—G. Bender.—An account of the behaviour of this ether with hydroquinon, resorcine, pyrocatechine, pyrogallic acid, phloro-glucine, ortho-cresol, meta-cresol, para-cresol, orcine, β-naphthol and α-naphthol.

On γ-Sulpho-iso-phthalic Acid and γ-Oxy-iso-phthalic Acid.—H. Lönnies.—A paper supplemental to that of K. Heine on the same subject.—See *Berichte*, v., 491.

Amarine and Lophine.—E. Fischer and H. Troschke.—The authors describe the transformation of amarine into lophine, the oxidation of lophine, disulpho-lophic acid, the action of bromine upon lophine, and the vapour-density of lophine.

The Fourth Mono-nitro-phenol.—F. Fittica.—This body is distinguished from ortho-nitro-phenol by its melting-point, and by the formation of a readily soluble sodium salt. It is decidedly more soluble in water than its isomer, and yields at 150° an amido-phenol, which melts at 150°, and dissolves readily in water, whilst ortho-amido-phenol does not melt below 170°, and dissolves in water with difficulty.

Certain Azo-Compounds (Continued from xiii., p. 43),—J. H. Stebbins.—An account of azo-benzol-oxy-carboxyl-benzol, parazo-sulphoxy-benzol-phloro-glucine, azo-benzol-diamido-toluol, diamido-azo-naphthaline, and azo-benzol-sulpho-cresol.

Lecture Experiments.—V. Merz and W. Weith.—These are the preparation of formic acid from carbonic oxide; the substitution of hydrogen for carbonic acid on the passage of the latter over soda-lime; the formation of oxalic acid from formic acid; the decomposition of the metallic iodides: the behaviour of hydrogen-sulphide with copper in presence of free oxygen as an instance of supplemental affinities, and the distinctions between spots of phosphorus and those of arsenic and antimony.

Action of Caustic Soda upon Cast-Iron.—H. Brunck and C. Graebe.—The compound produced is a ferric hydroxide, with a small percentage of manganese.

Action of Organic Acids upon Minerals.—An important paper, which will be introduced at length, if space permits.

Mucobromic Acid.—H. B. Hill.—The author studies the behaviour of muco-bromic acid with dry bromine.

The Oxidation-Products of Dimethyl-uric Acid.—C. F. Mabery and H. B. Hill.—The chief products are methyl-alloxan and methyl-urea, and methyl-paraban if the reaction is prolonged.

On α-tolyl-amide.—C. L. Reimer.—This compound, which is obtained as a by-product in the preparation of benzyl-cyanide, is represented by the formula C_8H_9NO.

Action of Bromine at High Temperatures upon Benzyl-cyanide and Phenyl-acetic Acid.— C. L. Reimer.—Among the products obtained and studied are dicyan-stilben, diphenyl-fumaric anhydride, and the corresponding ethyl-ether; diphenyl-fumarimide and benzoic acid produced from dicyan-stilben.

Constitution of Lactones.—Not suitable for useful abridgment.

Gum Lac from Arizona and California.—J. M. Stillman.—The Arizona lac appears to agree in composition with that from India.

Crystalline Quinoidine Borate.—J. Jobst.—The author disproves the existence of this alleged compound.

Methylen-caffeeic Acid, Methylen-homo-caffeeic Acid, and their Derived Acids.—C. Lorenz.—Not susceptible of useful abstraction.

Action of Organo-Zinc Compounds upon Quinones. Constitution of Phenanthren-quinone.—F. R. Japp.—This paper appears in full in the *Transactions of the Chemical Society*.

MISCELLANEOUS.

City and Guilds of London Institute for the Advancement of Technical Education.—Technological Examinations, May, 1881.—The City and Guilds of London Institute for the Advancement of Technical Education will afford facilities for carrying out an examination in any of the subjects enumerated in the Lists given below, wherever a class for instruction is formed, or a sufficient number of candidates present themselves, provided a Local Committee undertakes to carry out the examination according to the rules laid down in the programme. The Committee of any Art or Science School under the Science and Art Department, or any School Board, or any "Local Examination Board" connected with the Society of Arts, will be accepted as a suitable Committee for superintending the Institute's examinations. In special cases, also, the Institute may entertain propositions for the establishment of Special Local Committees for the Technological Examinations.

Subjects of Examination.

A.

1. Alkali Manufacture.
3. Cotton Manufacture.
5. Electro-Metallurgy.
7. Flax.
9. Fuel.
11. Glass Manufacture.
13. Mechanical Engineering.
15. Mine Surveying.
17. Oils, Colours, and Varnishes, Manufacture of.
19. Paper Manufacture.
21. Plumbers' Work, Zinc, and Tin-Plate Work.
23. Silk Manufacture.
25. Sugar Manufacture.
27. Telegraphy.
29. Watch and Clock Making.
31. Wool Dyeing.

B.

2. Brewing.
4. Calico Bleaching, Dyeing, and Printing.
6. Carriage Building.
8. Cloth Manufacture.
10. Gas Manufacture.
12. Silversmiths' Work.
14. Lace Manufacture.
16. Iron and Steel Manufacture.
18. Oils (Illuminating and Lubricating).
20. Ores, Mechanical Preparation of.
22. Photography.
24. Pottery and Porcelain.
26. Printing.
28. Silk Dyeing.
30. Tanning Leather.
32. Tools.

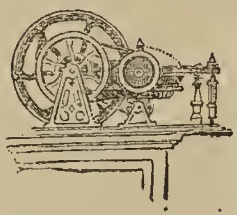
Candidates may be examined in any one subject out of list A, as well as in any one subject out of list B. The examinations will be in three grades:—I. Elementary; II. Advanced; III. Honours. Certificates (First and Second Class) will be awarded in each grade. The following Prizes will be offered in each subject:—Honours—1st Prize, £5 and a Silver Medal; 2nd Prize, £5 and a Bronze Medal. Advanced—1st Prize, £3 and a Silver Medal; 2nd Prize, £3 and a Bronze Medal. Elementary—1st Prize, £2 and a Silver Medal; 2nd Prize, £2 and a Bronze Medal. The examinations for the year 1881 will be held on the evenings of May 25 and May 26, the examinations in the subjects of list A on May 26, and in those of list B on May 25. There is no limit of age. Any persons desiring to be examined should apply not later than April 21, to the Central Office in London. Copies of the Programme, containing full particulars of the Examinations, a Syllabus of each subject, and the Examination Papers of 1880, can be obtained from the Central Office of the City and Guilds of London Institute, Gresham College, London, E.C.

MEETINGS FOR THE WEEK.

MONDAY, 31st.—London Institution, 5.
—— Medical, 8.30.
—— Royal Geographical, 8.30.
TUESDAY, 1st Feb.—Civil Engineers, 8.
—— Royal Institution, 3 p.m. "The Blood," Prof. Schäfer.
WEDNESDAY, 2nd.—Society of Arts, 8.
—— Pharmaceutical, 8.
—— Geological, 8.
THURSDAY, 3rd.—London Institution, 7.
—— Royal, 4.30.
—— Geologists' Association, 8.
—— Royal Institution, 3. "The Troubadours," Mr. F. Hueffer.
—— Chemical, 8. "On the Estimation of Organic Carbon in Air," Drs. Dupré and Hake. "On the Action of the Copper Zinc Couple upon Nitrates," Mr. W. Williams.
FRIDAY, 4th.—Royal Institution, 8. "Colonial Organisms," Dr. A. Wilson, 9.
SATURDAY, 5th.—Royal Institution, 3. "The Amazons," Prof. S. Colvin.

Carr's Patent Paint and Drug Mill.

Approved by some of the most eminent Chemists, and awarded the Silver Prize Medals of the Manchester and Liverpool, and the Middleton Agricultural Shows.



From Messrs. E. H. Smyth & Co., 21 Duke Street, Edinburgh, and 69, Coleman Street, City, London.—The small Levigator Mill we recently got from you works most efficiently, and is a great economiser of time.

The chief feature in this machine is, that although it can be turned with ease by a boy, it has immense frictional power for levigating purposes. This is caused by the runner being driven at a much greater speed, but in the same direction, than the bowl. The surfaces being Minton ware, they are clean, smooth, and durable.

Testimonials on application.

£11 nett cash, delivered in Manchester.

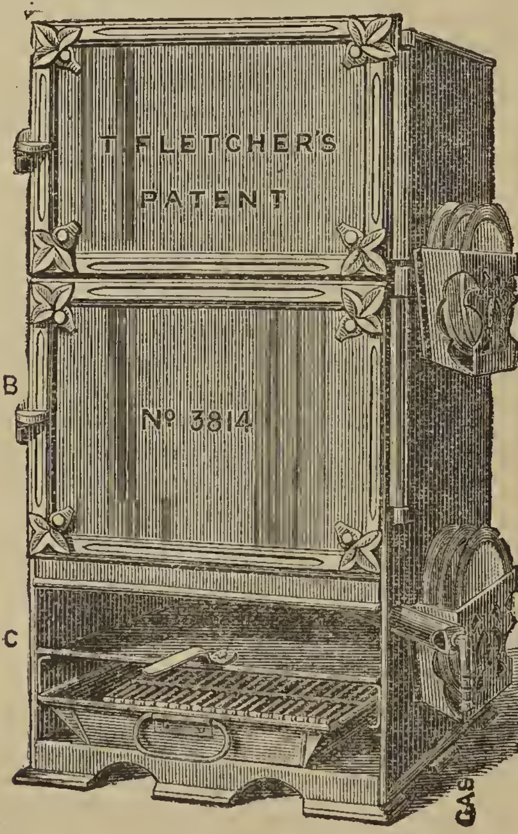
The diameter of the bowl is 18 ins., and it and the runners are made of Minton ware. It is useful for Painters, Chemists, Grocers, and Cooks, for triturating and mixing Medicines, Vegetable Powders, Ointments, Paints, Sugar, Salt, Spices, Herbs, Meat for Potting, and will grind the coarsest Emery into a nearly Impalpable Powder in a few seconds. The pan can be tilted for emptying, as shown in the dotted lines; it can be worked by hand or power.

SOLE MAKERS—

W. H. BAILEY & Co., Albion Works, Salford, Manchester.

FLETCHER'S
PATENT VENTILATED
HOT-AIR OVEN.

At a cost of less than one halfpenny per hour for gas, this oven will grill, roast, toast, bake, warm dishes and plates; and with the assistance of Fletcher's Patent Solid Flame Boiling Burners will do everything possible with a first rate open fire (except drying clothes on washing days).



It is unapproached by any oven for pastry, and is fully hot in one minute after the gas is lighted.

Fish, joint, and pastry can be cooked all at once, in the most perfect manner, without the slightest taint from one to the other. The cooking is always good and always alike.

It will roast joint and fowls both at once, at least as well as an open fire.

Complete illustrated list of gas cooking and labour saving appliances free by post. List of Gas and Petroleum Laboratory Furnaces and Apparatus, price 2d.

THOS. FLETCHER,
4 & 6, MUSEUM STREET, WARRINGTON.

MOTTERSHEAD & CO.,

7, Exchange Street and 10, Half Moon Street,
MANCHESTER.

CHEMICAL & PHYSICAL APPARATUS,
BOTTLES, PURE CHEMICALS,
REAGENTS, STANDARD SOLUTIONS,

And Every Requirement for Works' or School Laboratories or Private Students.

Illustrated Price Lists on application.

BERNERS COLLEGE of CHEMISTRY.

Instruction and preparation in CHEMISTRY and the EXPERIMENTAL SCIENCES under the direction of Professor E. V. GARDNER, F.A.S., M.S.A.

The Class Rooms are open from 11 to 5 a.m. and from 7 to 10 p.m daily.

Especial facilities for persons preparing for Government and other examinations.

Private Pupils will find every convenience.

Analyses, Assays, and Practical Investigations connected with Patents, &c., conducted.

Prospectuses and full particulars on application to Prof Gardne at Berners College, 44, Berners-street W.

MR. J. S. MERRY,

ASSAYER AND ANALYTICAL CHEMIST,
SWANSEA.

BISULPHITE OF LIME.
BISULPHITE OF SODA.
SULPHITE OF SODA. TANNATE OF SODA.

WILLIAM MARRIOTT
CHEMICAL WORKS, HUDDERSFIELD

ASBESTOS.

H. W. JOHN'S MANUFACTURING CO. have appointed WITTY and WYATT Sole European and Colonial Agents for their well known ASBESTOS Fire-proof Paints and other materials, which for twenty years have been largely used in the United States, South America, China, Japan, &c.

ASBESTOS RETORT CEMENT is Fire- and Acid-Proof; when subjected to intense heat will vitrify without shrinking, thus rendering it of great value in repairing retorts, pipes, and other chemical appliances.

WITTY AND WYATT, 9, Fenchurch Street, EC.
ASBESTOS WAREHOUSES, 1, Fenchurch Avenue.

Water-Glass, or Soluble Silicates of Soda and Potash, in large or small quantities, and either solid or in solution, at ROBERT RUMNEY'S Ardwick Chemical Works, Manchester.

THE CHEMICAL NEWS
AND
JOURNAL OF PHYSICAL SCIENCE.

Edited by WILLIAM CROOKES, F.R.S.

Published every Friday. Price 4d. Annual Subscription, post free including Indices, £1

CHARGES FOR ADVERTISEMENTS.

	£	s.	d.
Five lines in column (about 10 words to line)	0	3	6
Each additional line	0	0	6
Whole column	1	15	0
Whole page	3	0	0

A reduction made for a series of insertions.

Cheques and Post-Office Orders, crossed "London and County Bank," payable to the order of William Crookes.

BOY COURT, LUDGATE HILL, LONDON, E.C.

THE CHEMICAL NEWS.

Vol. XLIII. No. 1105.

CONTRIBUTIONS TO THE EXAMINATION OF WINE.

By V. WARTHA.

1. *Detection of Magenta in Red Wines.*

In all judicial cases the following should be applied in succession :—

a. The Magnesia Test.—20 c.c. of the wine are mixed in a large test-tube with excess of calcined magnesia. After well shaking there is added 1 c.c. of a mixture of equal parts colourless amylic alcohol and ether; the whole is well shaken and allowed to stand for some time. 1 m.grm. magenta in 1 litre wine may be detected by a rose colouration of the supernatant stratum. In strongly coloured southern wines faint reactions are often masked by a yellowish or light brownish colouring-matter.

b. The Sugar of Lead Test.—20 c.c. of wine are mixed with 10 c.c. sub-acetate of lead of officinal strength, and the mixture after being well shaken is filtered into a perfectly dry test-tube. If moderately large quantities of magenta are present they will be detected by the paler or deeper rose colour of the filtrate. But even if it appears perfectly colourless or yellowish, small quantities of magenta or aniline-violet may be present. 1 c.c. of the above-mentioned mixture of amylic alcohol and ether is therefore added; the tube shaken up, and then allowed to stand for some time. If held against a white background very small quantities of magenta may be recognised in the upper stratum.

c. The Ether Test.—If the sample has given strong reactions with *a* and *b*, concentration is not necessary. If the reactions were slight, from 150 to 200 c.c. of the wine are evaporated down to one-third to one-fifth of its original volume in a silver capsule, which should have been slightly ignited previously. The concentration is effected over an open flame as rapidly as possible, and the residue while still warm is poured into a stoppered glass cylinder, which should previously be washed with concentrated nitric acid and rinsed with pure water. The wine is mixed with an excess of pure ammonia, 30 to 40 c.c. pure ether are added, the cylinder is stoppered, and shaken carefully to prevent the formation of an emulsion. The clear ethereal stratum is then filtered through a clean dry filter into a perfectly clean porcelain capsule having glazed edges. One or two threads of clean knitting-wool, 3 to 4 c.m. long, which should have been previously washed and dried, are laid in the colourless ether, which is allowed to evaporate in a warm place. The wool takes a colour which may vary, according to the proportion of the magenta, from a faint rose to a red. One of the threads is then reserved in a tube, whilst the other is cut in two, the one half moistened with hydrochloric acid, and the other with ammonia. In both these the red colour should change to a yellowish. If aniline-violet was present the threads will turn to a green. If the wine was pure, however deep in colour, the wool remains white. Particular care must be taken that the ammonia employed contains no traces of organic colouring-matters.

2. *Detection of Sulphurous Acid in Wines.*

About 50 c.c. of the sample are placed in a small distilling flask, the lateral exit-tube of which projects into a test-tube cooled with moistened filter-paper. The wine is kept at a gentle boil till 2 c.c. have distilled over. The test-tube is taken off and a few drops of a neutral solution of silver nitrate are added. If even traces of sulphurous acid were present the liquid becomes opalescent or a white curdy precipitate of silver sulphite is formed, which is distinguished from silver chloride by its solubility in nitric acid. The distillate also reduces mercurous nitrate and decolourises starch iodide and weak solution of potassium permanganate.—*Berichte der Deut. Chem. Gesellschaft zu Berlin*, No. 6, 1880.

LONDON WATER SUPPLY.

Report on the Composition and Quality of Daily Samples of the Water Supplied to London, from December 20th, 1880, to January 19th, 1881

By WILLIAM CROOKES, F.R.S.,
WILLIAM ODLING, M.B., F.R.S., F.R.C.P.,
Professor of Chemistry at the University of Oxford;
and C. MEYMOTT TIDY, M.B., F.C.S.,
Professor of Chemistry and of Forensic Medicine at the London Hospital; Medical Officer of Health for Islington.

To the Right Honourable the President of the Local Government Board.

January 21, 1881.

Sir,—We desire to lay before you the results of our examinations and analyses of daily samples of the water delivered in London by the seven Companies deriving their supply from the Rivers Thames and Lea, for the month ending Jan. 19th. The samples are collected by a man entirely under our own control, at places and at times appointed by us, and unknown to the officers of the several Companies.

As yet no daily analyses of the London waters have been recorded. All the reports hitherto published relate to a single sample of each Company's water taken on one day only in the course of a month. It is manifestly impossible to judge the character of a whole month's supply by a single sample. This may prove to be very good, whilst the water supplied during the rest of the month may be very bad or *vice versâ*.

In Table I. we have recorded the analyses in detail of a daily sample (excluding Sundays and Christmas Day) between Dec. 20th, 1880, and Jan. 19th, 1881.* The purity of the water in respect of organic matter, has been determined by the oxygen and the combustion processes, the results of our analyses by these methods being stated in columns XIV. to XVIII.

In Table II. is recorded the colour, together with the clearness or turbidity of each sample. Of the 169 samples collected by us between Dec. 20th, 1880, and Jan. 20th, 1881, 139 were found "*clear*," 21 were noted as "*very slightly turbid*," 8 as "*slightly turbid*," and 1 as "*turbid*."

The samples supplied by the New River Company were, without exception, clear, bright, and efficiently filtered.

Of the 24 samples from the mains of the East London Company, 2 were noted as "very slightly turbid." The remainder were, bright, clear, and well filtered.

Of the 24 samples from the mains of the Chelsea Water Company, 2 were noted as "very slightly turbid." The remainder were bright, clear, and well filtered.

Of the 25 samples from the mains of the West Middlesex Company, 1 was noted as "very slightly turbid." The remainder were clear, bright, and well filtered.

Of the 24 samples from the mains of the Lambeth Water Company, 3 were noted as "very slightly turbid," and 4 as "slightly turbid." The remainder were clear, bright, and well filtered.

Of the 24 samples from the mains of the Grand Junction Company, 6 were noted as "very slightly turbid," 4 as "slightly turbid," and 1 as "turbid." The remainder were clear, bright, and well filtered.

Of the 24 samples from the mains of the Southwark

---

* The severe weather interfered with the collection of samples on the 18th and 19th of January.

TABLE I.

RESULTS OF THE ANALYSIS OF DAILY SAMPLES OF THE WATER AS SUPPLIED TO THE METROPOLIS, FOR THE MONTH ENDING JANUARY 19TH, 1881.

The Results are stated in Grains per Imperial Gallon of 70,000 *Grains, except the Organic Carbon and Nitrogen, which are expressed both in Grains per Gallon and in Parts per* 100,000.

I. No.	II Date of Collection.	III. Time of Collection.	IV. Company from the Mains of which the Sample was drawn.	V. Place where the sample was drawn.	VI. Appearance in 2-ft. tube.*	VII. Matters in Suspension.	VIII. Ammonia.	IX. Chlorine	=	X. Common Salt (NaCl).	XI. Nitrogen	=	XII. Nitric Acid (HNO$_3$).	XIII. Initial Hardness.	XIV. Oxygen required to Oxidise the Organic Matter. †	XV. Organic Carbon.	XVI. Organic Nitrogen.	XVII. Organic Carbon.	XVIII. Organic Nitrogen.
						Grains.	Grains.	Grains	=	Grains.	Grains	=	Grains.	Degrees.	Grains.	Prts. per 100,000.		Grs. per Glln.	
	1880-81.	p.m.																	
1	Dec. 20	6. 0	New River	Islington Green	C.	None.	0·000	1·152	=	1·888	0·219	=	0·985	15·4	0·020	0·108	0·014	0·075	0·009
8	,, 29	5.30	New River	Islington Green	C.	None.	0·000	1·008	=	1·652	0·229	=	1·030	15·4	0·060	0·152	0·030	0·106	0·021
15	Jan. 6	6.25	New River	Islington Green	C.	None.	0·000	1·008	=	1·652	0·240	=	1·080	15·4	0·039	0·108	0·012	0·076	0·008
22	,, 14	3.15	New River	Islington Green	C.	None.	0·000	1·008	=	1·652	0·250	=	1·125	16·5	0·040	0·122	0·026	0·085	0·016
2	Dec. 21	4. 0	East London	London Hospital College	V. S. T.	? ‡	0·000	1·080	=	1·770	0·208	=	0·936	15·9	0·054	0·172	0·023	0·120	0·016
9	,, 30	2.10	East London	London Hospital College	C.	None.	0·000	1·008	=	1·652	0·208	=	0·936	15·9	0·060	0·146	0·028	0·102	0·019
16	Jan. 7	4.50	East London	London Hospital College	C.	None.	0·000	1·152	=	1·888	0·188	=	0·846	15·4	0·056	0·151	0·028	0·105	0·019
23	,, 15	5. 0	East London	London Hospital College	C.	None.	0·000	1·008	=	1·652	0·240	=	1·080	16·5	0·048	0·116	0·020	0·081	0·014
3	Dec. 22	8. 0	Chelsea	Horse Guards	V. S. T.	? ‡	0·000	1·080	=	1·770	0·208	=	0·936	16·5	0·031	0·100	0·016	0·070	0·011
10	,, 31	7.45	Chelsea	Horse Guards	C.	None.	0·000	1·008	=	1·652	0·198	=	0·891	14·8	0·068	0·214	0·032	0·149	0·022
17	Jan. 8	8. 0	Chelsea	Horse Guards	C.	None.	0·000	1·008	=	1·652	0·167	=	0·752	15·4	0·061	0·182	0·030	0·127	0·021
24	,, 16	3. 0	Chelsea	Horse Guards	C.	None.	0·000	1·008	=	1·652	0·198	=	0·891	15·9	0·048	0·131	0·022	0·091	0·015
4	Dec. 23	7.30	West Middlesex	Portland Road	C.	None.	0·000	1·008	=	1·652	0·203	=	0·913	15·9	0·017	0·110	0·020	0·077	0·014
11	Jan. 1	6.15	West Middlesex	Portland Road	C.	None.	0·000	1·008	=	1·652	0·188	=	0·846	15·4	0·086	0·226	0·032	0·158	0·022
18	,, 10	6.20	West Middlesex	Portland Road	C.	None.	0·000	1·008	=	1·652	0·198	=	0·891	15·9	0·068	0·227	0·031	0·158	0·021
25	,, 19		West Middlesex	Portland Road	C.	None.	0·000	1·080	=	1·770	0·198	=	0·891	16·5	0·056	0·162	0·022	0·113	0·015
5	Dec. 24	7. 0	Lambeth	Westminster Bridge Road	C.	None.	0·000	1·080	=	1·770	0·198	=	0·891	15·9	0·066	0·145	0·034	0·108	0·023
12	Jan. 3	7.45	Lambeth	Westminster Bridge Road	S. T.	? ‡	0·001	1·080	=	1·770	0·198	=	0·891	15·4	0·090	0·274	0·042	0·191	0·029
19	,, 11	7.55	Lambeth	Westminster Bridge Road	C.	None.	0·000	1·008	=	1·652	0·198	=	0·891	16·5	0·040	0·123	0·022	0·086	0·015
6	Dec. 27	2.20	Grand Junction	Lancaster Gate	C.	None.	0·000	1·080	=	1·770	0·198	=	0·891	16·5	0·088	0·248	0·042	0·173	0·029
13	Jan. 4	6.50	Grand Junction	Lancaster Gate	S. T.	? ‡	0·001	1·008	=	1·652	0·188	=	0·846	15·0	0·096	0·273	0·040	0·191	0·028
20	,, 12	6.45	Grand Junction	Lancaster Gate	C.	None.	0·001				0·240	=	1·080	15·9	0·048	0·174	0·032	0·121	0·022
7	Dec. 28	8.25	Southwark and Vauxhall	St. George's Church, Boro'	C.	None.	0·001	1·152	=	1·888	0·198	=	0·891	14·3	0·106	0·314	0·044	0·219	0·030
14	Jan. 5	8.20	Southwark and Vauxhall	St. George's Church, Boro'	C.	None.	0·001	1·008	=	1·652	0·188	=	0·846	14·8	0·086	0·254	0·038	0·177	0·026
21	,, 13	9.35	Southwark and Vauxhall	St. George's Church, Boro'	V. S. T.	? ‡	0·000	1·008	=	1·652	0·229	=	1·030	16·0	0·048	0·150	0·036	0·105	0·025

* See Table II. † The amount of oxygen is determined by a standard solution of Potassic Permanganate in the cold acting for three hours. ‡ Incapable of estimation.

TABLE II.

Showing the Appearance in a Two-foot Tube, and Condition, as Regards Turbidity, of the Waters Daily Supplied to the Metropolis by the London Companies, for the Month ending, January 19th, 1881.

No.	Date of Collection.	New River Company.		East London Company.		Chelsea Company.		West Middlesex Company.		Lambeth Company.		Grand Junction Company.		Southwark and Vauxhall Compy.	
	1880.														
1	Dec. 20	C.	G. 0	C.	G. 0	V. S. T.	G. 1	C.	G. 0	C.	Y. G. 1	C.	G. 2	V.S.T.	G. 2
2	,, 21	C.	G. 0	V. S. T.	G. 1	C.	G. 1	C.	G. 0	C.	Y. G. 1	C.	G. 2	V.S.T.	Y. G. 2
3	,, 22	C.	G. 0	C.	G. 1	V. S. T.	G. 1	V. S.T.	G. 1	C.	Y. G. 1	T.	Y. G. 2	V.S.T.	Y. G. 2
4	,, 23	C.	G. 0	C.	G. 1	C.	G. 1	C.	G. 2	C.	Y. G. 1	V. S. T.	Y. G. 2	C.	Y. G. 2
5	,, 24	C.	G. 1	C.	G. 1	C.	G. 1	C.	Y. G. 1	C.	Y. G. 1	S. T.	Y. G. 2	C.	Y. G. 2
6	,, 27	C.	G. 1	C.	G. 2	C.	G. 2	C.	Y. G. 1	C.	Y. G. 2	C.	Y. G. 2	C.	Y. G. 2
7	,, 28	C.	G. 1	C.	G. 1	C.	G. 2	C.	Y. G. 1	S. T.	Y. G. 2	V. S. T.	Y. G. 2	C.	Y. G. 2
8	,, 29	C.	G. 0	C.	G. 0	C.	G. 2	C.	Y. G. 1	C.	Y. G. 2	V. S. T.	Y. G. 2	C.	Y. G. 2
9	,, 30	C.	G. 1	C.	G. 1	C.	G. 2	C.	Y. G. 2	C.	Y. G. 2	C.	Y. G. 2	C.	Y. G. 2
10	,, 31	C.	G. 0	C.	G. 1	C.	G. 1	C.	Y. G. 2	S. T.	Y. G. 2	C.	Y. 2	C.	Y. 2
	1881.														
11	Jan. 1	C.	G. 1	C.	G. 1	C.	G. 2	C.	Y. G. 2	S. T.	Y. G. 2	S. T.	Y. 2	C.	Y. G. 2
12	,, 3	C.	G. 0	C.	G. 1	C.	G. 2	C.	Y. G. 2	S. T.	Y. G. 2	S. T.	Y. G. 2	C.	Y. 2
13	,, 4	C.	G. 1	C.	G. 1	C.	G. 1	C.	Y. G. 1	V. S. T.	Y. 2	S. T.	Y. G. 2	V. S. T.	Y. 2
14	,, 5	C.	G. 0	C.	G. 1	C.	Y. G. 1	C.	G. 1	C.	G. 2	C.	Y. G. 2	C.	Y. G. 1
15	,, 6	C.	G. 1	V. S. T.	G. 2	C.	G. 1	C.	G. 1	V. S. T.	Y. G. 1	V. S. T.	Y. G. 1	C.	Y. G. 1
16	,, 7	C.	G. 1	C.	G. 1	C.	G. 1	C.	G. 1	C.	Y. G. 1	V. S. T.	Y. G. 1	C.	Y. G. 1
17	,, 8	C.	G. 1	C.	G. 1	C.	G. 1	C.	G. 1	C.	G. 1	V. S. T.	Y. G. 1	C.	Y. G. 1
18	,, 10	C.	G. 1	C.	G. 1	C.	G. 1	C.	Y. G. 1	C.	G. 1	C.	Y. G. 1	C.	Y. G. 1
19	,, 11	C.	G. 0	C.	G. 1	C.	Y. G. 1	C.	Y. G. 1	C.	G. 1	C.	G. 1	C.	Y. G. 1
20	,, 12	C.	G. 0	C.	G. 1	C.	G. 1	C.	G. 1	V. S. T.	Y. G. 1	C.	Y. G. 1	C.	Y. G. 1
21	,, 13	C.	G. 1	C.	G. 1	C.	G. 1	C.	G. 1	C.	G. 1	C.	G. 1	V. S. T.	G. 1
22	,, 14	C.	G. 0	C.	G. 1	C.	G. 2	C.	G. 2	C.	G. 2	C.	G. 1	V. S. T.	G. 2
23	,, 15	C.	G. 1	C.	G. 1	C.	G. 2	C.	G. 2	C.	G. 1	C.	G. 1	C.	Y. G. 1
24	,, 17	C.	G. 1	C.	G. 2	C.	G. 2	C.	G. 1	C.	G. 1	C.	G. 1	V. S. T.	Y. G. 1
26	,, 19	—		—		—		C.	G. 2	—		—		—	

Degrees of Turbidity.

Note :— C. = Clear.
V. S. T. = Very slightly turbid.
S. T. = Slightly turbid.
T. = Turbid.

Degrees of Tint Depth.

Note :— B. = Blue.
G. 0 = Green.
G. 1 = Green 1.
G. 2 = Green 2.
Y. G. 0 = Yellowish green.
Y. G. 1 = Yellowish green 1.
Y. G. 2 = Yellowish green 2.
Y. 0 = Yellowish.
Y. 1 = Yellowish 1.
Y. 2 = Yellowish 2.

TABLE III.

Showing the Quantity of Free Oxygen in Daily Samples of the Water supplied to the Metropolis, for the Month ending January 19, 1881.

The Results are stated in Cubic Inches per Imperial Gallon.

No.	Date of Collection.	New River Company.	East London Company.	Chelsea Company.	West Middlesex Company.	Lambeth Company.	Grand Junction Company.	Southwark and Vauxhall Company.
	1880.							
1	Dec. 20	1·76	1·85	1·68	1·85	1·85	1·85	1·76
2	,, 21	2·24	1·76	1·85	2·13	1·68	2·13	1·68
3	,, 22	1·96	1·85	1·79	1·85	1·79	2·04	1·57
4	,, 23	1·85	1·76	1·79	1·76	1·73	2·13	1·93
5	,, 24	1·68	1·57	1·69	1·57	1·71	1·68	1·93
6	,, 27	1·76	1·93	1·57	1·76	1·62	1·68	1·51
7	,, 28	1·58	1·59	1·59	1·68	1·48	1·68	1·59
8	,, 29	1·51	1·57	1·60	1·43	1·57	1·43	1·59
9	,, 30	1·51	1·48	1·59	1·57	1·82	1·59	1·59
10	,, 31	1·62	1·83	2·43	1·43	2·32	1·59	2·43
	1881.							
11	Jan. 1	2·04	2·01	2·46	2·05	2·30	1·73	2·27
12	,, 3	2·43	2·04	2·10	2·30	2·00	1·98	1·98
13	,, 4	2·35	2·04	1·90	2·18	2·07	2·15	1·98
14	,, 5	2·07	2·13	2·30	1·98	1·98	2·01	2·28
15	,, 6	2·10	1·79	2·21	2·24	2·24	2·46	2·24
16	,, 7	2·21	1·69	2·01	2·32	1·62	2·21	1·96
17	,, 8	1·90	1·71	2·10	2·07	1·62	1·85	2·10
18	,, 10	1·88	1·71	2·60	2·10	2·68	2·18	2·68
19	,, 11	2·68	2·68	2·27	2·66	2·21	2·57	2·66
20	,, 12	2·28	2·21	2·15	2·49	2·32	2·43	2·50
21	,, 13	2·57	2·18	2·38	2·50	2·32	2·38	2·46
22	,, 14	2·43	2·46	2·41	2·66	2·38	2·55	2·60
23	,, 15	2·50	2·18		1·99		2·38	
24	,, 17							
25	,, 18							
26	,, 19							

and Vauxhall Company, 7 were noted as "very slightly turbid." The remainder were clear, bright, and efficiently filtered.

If a trace of suspended matter be noted, we record the water as "turbid." If on close scrutiny we are able to detect any suspended matter whatever, we call the water "very slightly turbid." A water is recorded as "slightly turbid" when we consider it would come between those two extremes.

In Table III. we have recorded the quantity of free oxygen in the 158 samples.

We desire to add, that from these analyses we are of opinion that considered both chemically and physiologically, the water delivered by the Companies during the month over which these examinations extended was of excellent quality, wholesome, and in every respect well fitted for the supply of the Metropolis.—We remain, Sir, your faithful servants,

William Crookes,
William Odling,
C. Meymott Tidy.

REMARKS ON "SOME EXPERIMENTS WITH MALTOSE."

By J. STEINER, F.C.S.

The paper published by Mr. Yoshida in the Chemical News, vol. xliii., p. 29, though interesting, seems to me to require correcting in some points.

1. The specific rotatory power of maltose, if calculated from the appended analytical data, is not $(\alpha)j = 150{\cdot}25$, but less. Mr. Yoshida used Soleil-Ventzke's saccharimeter for examining the optical properties of his crystallised sugar. Now the number of angular degrees corresponding to 100 divisions on the scale of this instrument, is not 39·61, as introduced in his calculations, but less. 26·048 grms. of pure cane-sugar dissolved to 100 c.c., causes in a layer of 200 m.m., a rotation which is marked on the scale of this apparatus as 100. From experiments concerning the rotatory power of cane-sugar, as carried out by Tollens and also by Schmidt, it follows that this concentration in the given length produces a deviation of the sodium ray which equals 34·6 angular degrees. Further, it is an established fact that quartz disperses the single rays of the white light in exactly the same manner as is done by cane-sugar in aqueous solutions. Broch, who examined very carefully the optical activity of quartz, noticed for a plate of 1 m.m. in thickness a deviation of 21·67 angular degrees for the sodium light and 24·5 for the white lamp light. These data may be arranged in the following proportion, $21{\cdot}67 : 24{\cdot}5 = 34{\cdot}6 : (x = 39{\cdot}1)$, which shows that for 100 divisions of Soleil-Ventzke's scale 39·1 angular degrees have to be taken into account, when the specific rotatory power for the transition tint $(\alpha)j$ is to be calculated for. On using the factors 34·6 and 39·1 in conjunction with Mr. Yoshida's analytical data the values $(\alpha)_D = 131{\cdot}3$ and $(\alpha)j = 148{\cdot}3$ are obtained, and they are remarkable for being very low.

Mr. Yoshida does not mention anything about the water of hydration of maltose crystals, and yet it is well known that maltose crystallises with one molecule of water, which corresponds to an increase in weight of 5 per cent. Suppose Mr. Yoshida used crystals for his experiments, then the numbers for the specific rotation would have to be increased in the proportion of 95 : 100, and the results would be $(\alpha)_D = 138{\cdot}2$ and $(\alpha)j = 156{\cdot}1$ for anhydrous maltose.

A few months ago, Prof. Soxhlet, in Munich, kindly gave to me a sample of his specially purified and distinctly crystalline maltose. A solutions of it, containing 11 per cent of perfectly air dry crystals, and being quite colourless and bright, was examined in a Ventzke-Scheibler polarimeter, with the result of $(\alpha)_D = 138{\cdot}9$ for anhydrous maltose. Dr. Meissl in Vienna, who examined solutions containing about 20 per cent of dry maltose, obtained the value $(\alpha)_D = 139{\cdot}3$. Mr. Yoshida used solutions with 6·4 and 10 grms. per 100 c.c., and it seems most probable that the numbers given by him are merely the values for crystallised maltose.

There is another point concerning the rotation of maltose which requires mentioning, and it is this: Soxhlet noticed that maltose solutions possess the peculiar property of what is called by-rotation, similarly as is the case with dextrose. But while the optical activity of dextrose decreases considerably after 24 hours standing, or half an hour's boiling, the deviation caused by maltose becomes somewhat greater in a few hours from the time when it was dissolved. The sample of maltose which was examined by myself showed a distinct by-rotation. Mr. Yoshida does not mention anything on this point, and it is likely that he did not take it into consideration.

2. In regard to the determination of the CuO reducing power of maltose, there is this to be said: Soxhlet found out by experiments that the concentration of the copper and sugar solution influences the reducing power of different sugars. Concerning maltose it has been established that the reducing action increases with the dilution of the test liquor. If, however, Fehling's solution is applied without diluting it, the action of maltose, in a solution containing no more than about 1 per cent of this sugar, is independent of the excess of test liquor, and in this case 100 maltose are equivalent to 113 copper or 141·5 CuO. Now Mr. Yoshida diluted his copper solution five times, and yet he obtained only 460·31 CuO for one equivalent (342) of maltose, *i.e.*, 134·62 CuO for 100 maltose. This result also seems to me to prove that the CuO reducing power calculated by him as 61, is that of the crystals, while the proportion, $95 : 100 = 61 : (x = 64{\cdot}2)$, shows that for anhydrous maltose $K = 64{\cdot}2$. Mr. Yoshida operated under circumstances which are similar to those used and recommended by Mr. O'Sullivan, and naturally enough the result differs not much from the value $K = 65$ as given by that investigator.

3. The experiments carried out by Mr. Yoshida for the purpose of studying the reducing action of maltose on an ammoniacal copper solution are interesting, as they show the effect produced by using ammonia of different strength for this test.

The reducing power of maltose is not so easily influenced, as is the case for that of dextrose or glucose, on varying the strength and amount of ammonia of the test. A direct comparison, however, of the ammoniacal test with the ordinary copper test is not given by Mr. Yoshida. The actual influence of more or less alkali in Pavy's test liquor, has first been pointed out by Mr. Hehner, while a close comparison of the results obtained with the two tests were given by myself (Chemical News, vol. xl., p. 139) in the following manner: 20 c.c. of Fehling's solution were applied for the usual test, and then I repeated the experiment with the same amount of test liquor after the addition of 40 c.c. of strong ammonia. I then noticed that the action of maltose remained the same in both cases, while with dextrose and invert-sugar, the reduction became more energetic in presence of ammonia.

4. The result of the action of glacial acetic acid upon maltose is very satisfactory if the method described by Liebermann and Hormann is applied. Equal quantities of dry substance and acetate of soda are mixed with about 3 to 4 times of acetic anhydride and warmed in a flask. The action being very energetic, is completed in 10 to 15 minutes. After cooling the flask a solid cake is obtained, and on the addition of an excess of water, the maltose acetyl separates in flocks, which are soluble in hot alcohol. On gradually evaporating the spirit, crystals separate, which represent the highest acetyl derivate of maltose.

An elementary analysis of this substance, carried out by Herzfeld, yielded results which agree closely with the formula—

$$\underbrace{C_{12}H_{10}O_{11}.(C_2H_3O)_{12}.}$$

It is clear that in this case a conclusion as to the nature and constitution of the maltose molecule can be drawn much easier than if merely the mono-acetyl derivate is taken into consideration.

ON THE
CHEMISTRY OF SEWAGE PRECIPITATION.*
By Dr. WILLIAM WALLACE.

The subject which I propose to bring before you is one to which, for several years, I have devoted much attention, and I have thought that it might not be uninteresting to the members of the Section to have it introduced to their notice. Although it is with precipitation of sewage that we have to do, yet I trust you will bear with me if I digress at times into collateral branches of the subject.

There are three distinct products of the animal body:—First, there is the gaseous, consisting chiefly of carbonic acid gas and watery vapour, resulting from the oxidation of the respiratory food,—fat, sugar, starch, and so on—and this may be called the gaseous refuse or sewage of the body; second, there is the liquid excrement or urine, and this consists essentially of water holding in solution the partially-oxidised products of the waste tissues of the body; lastly, there is the solid excrement, consisting of that portion of our food which has escaped digestion, but altered to some extent by the functions of the body. It is with the two latter alone that we are concerned. They form the most important and essential portion of sewage. But there are other sources of pollution—that is, putrescible matter—besides the animal products. These consist of such things as the water poured off from boiled vegetables and meat, the washings of dishes and kitchen utensils, the water used in washing our own bodies and in washing clothes, the surface drainage of the streets; besides refuse matter of various kinds from workshops and factories, chemical works, breweries, distilleries, and so on. Sewage is thus a very mixed liquid, and this is one of the difficulties of disposing of it. Still, it is a thing we have to deal with, and, such being the case, the question is how to get rid of it in the most convenient, the least injurious, and the least expensive manner.

There can be little doubt as to the original method of disposing of the animal products in what may be called the normal state of existence, when every family lived apart, surrounded by plenty of ground. Yet even in ancient times it was found necessary, for the well-being of the community, as we find described in the Mosaic record, to make sanitary regulations for the proper disposal of the excreta of the camp or household. As families began to congregate into towns the difficulties increased; and it is one of the great evils of town life that no perfect system for dealing with excreta has yet been carried out. If we examine towns where a dry system alone is in operation, as in most of the inland Continental towns, we find that there is a general unsavouriness about them, while the closets are generally odorous to a painful degree. On the other hand, the wet system has evils peculiar to itself, although, upon the whole, a water-closet town is cleaner and less offensive than the other description: yet its underground sewers generate gases, by which the soil is permeated and the houses rendered unwholesome; and the gases escaped through imperfect traps and corroded pipes into the houses. If the sewers could all be kept on the surface of the ground, with a constant run of water in them, there would be no danger from this cause; for sewage mixed with sufficient water to ensure it being kept in motion and freely exposed to the air, will never become dangerous to health, although it may be more or less offensive to the senses of sight and smell. Perhaps the most perfect town, sanitarily, that we could imagine would be one which had in the centre of every street a copious stream of water running in a perfectly smooth channel, and with sufficient fall to prevent any lodgment of solid matter. Into this stream the sewage of every house would pass, and it might be covered over at intervals, or even throughout its whole length, with a grating so open as to give perfect access of air to the stream below, its bed being only a few inches below the level of the street. It is when excretal matter is shut up that it becomes dangerous to health. Nature has provided for its deodorisation and oxidation by mixture with the porous soil and free exposure to the air; and if we defy nature, as it were, by keeping it underground, shut up from the purifying influence of atmospheric oxidation, we must be content to reap the consequences in a class of diseases which appear to be peculiarly the result of the decomposition of excremental matter under these conditions.

A great deal has been said and written about the purifying action of water, but I wish to point out to you that water, *per se*, has no purifying action whatever. If we were to mix excreta with pure or boiled water it would certainly dilute it, but it would not prevent its decomposition and consequent offensiveness in the slightest degree. But water in nature is never pure—it contains in solution both mineral salts and gases, one of which is oxygen, which usually constitutes one-third of the whole. This oxygen in water undoubtedly exerts a most powerful influence on sewage, but then it requires an enormous volume to yield sufficient oxygen to render innocuous a very small quantity of excreta. A gallon of water contains, we may assume, 2½ cubic inches of oxygen gas, but the weight of this is only 0·9 of a grain; while, according to my calculation, a gallon of urine would require for its complete oxidation about 3000 grains of oxygen. It is only in extreme cases that we can have the opportunity of mixing animal products with 3000 times their bulk of water; but if we could do so, and provided there was no solid matter to settle down, there would be complete oxidation and purification. In ordinary cases we have to depend more upon contact with the air for the oxidation than the mere mixture of water, which, as I have shown you, possesses but a limited power. With regard to river pollution, the influence of sewage must be considered with reference to quantity. For example, the drainage of a small village somewhere about Tintock would be completely swallowed up and rendered perfectly harmless before it reached Glasgow; but when we throw into the Clyde the excrements of nearly three-quarters of a million of people, we tax the powers of air and water too severely, and the once noble river becomes, at the harbour, a seething puddle, a gigantic cesspool. And yet it has by no means been satisfactorily proved that the condition of the river, disgusting as it is in summer, is directly dangerous to health. The question of the conservancy of rivers is one that has for some time been engaging the attention of sanitary authorities. In the case of a number of towns, such as Bradford and Leeds, the purified sewage is incomparably purer than the grossly-polluted streams into which it flows. These and other towns are subjected to the manifest injustice of being compelled, under heavy penalties, to render their sewage clear, inodorous, and almost perfectly colourless, before discharging it into rivers or streams, which are often, as in the case of the Bradford Beck, literally common sewers of the foulest description. The inhabitants of these towns complain, and with good reason, that in the upper reaches of the rivers wholesale pollution is permitted, while they have been put to great expense in order to accomplish a purification, the effects of which are swallowed up in the filth of other towns over which they have no control. Conservancy Boards to watch over the whole drainage area of the various river basins appear to be the only effectual means of solving the important questions which are so intimately connected—the disposal of sewage and the restoration of rivers to a state of purity.

There are two ways in which excremental matter may be dealt with—the dry system, and carriage by water,

---

* A Paper read before the Chemical Section of the Philosophical Society of Glasgow, December 6, 1880.

The first is the most rational, as well as the most consistent with public health and with national prosperity. The weak part of this system is that, while it disposes of excreta, it leaves untouched all other kinds of sewage, which still require to be removed by means of water-carriage, and demand the same purification before passing into a river as the excreta themselves. While, therefore, upon economical and sanitary grounds, water-closets, especially in houses of the smaller sort, and in public works, jails, railway stations, &c., might, with advantage, be replaced by an efficient dry system, the adoption of this course would not greatly lessen the ammont of sewage to be dealt with, or render its purification less imperative.

When water-cariage is used, the following methods may be employed for the disposal of the sewage:—

1st. Running it into the sea, or into a tidal river, under conditions that will prevent its return,
2nd. Irrigation,
3rd. Purification by precipitation—
  (a.)—By lime.
  (b.)—By sulphate of alumina.
  (c.)—By the A B C system.

The system recommended by Sir John Hawkshaw for the disposal of the Glasgow sewage is to pump it up to a high level, and to carry it down to the Ayrshire coast, and then run it into the sea. Perhaps the most serious objection to the adoption of this recommendation is, that it ignores the broad principle that the people of one river basin or drainage area should not be permitted to invade another district, in order to get rid of their sewage, but should restore it to their own river in a form sufficiently purified to prevent nuisance, and allow of the water of the river being used, to a large extent at least, for primary purposes. Apart from the enormous cost of Sir John Hawkshaw's scheme—in itself a serious obstacle to its adoption—it appears unlikely that Parliamentary sanction would be obtained in opposition to the wishes of the inhabitants of a large district with which the city of Glasgow has no connection, and to which it has no legitimate claim. The example of London in running the unpurified sewage into the Thames is scarcely one that can be followed by Glasgow. The average range of the tide in the Thames is 18 feet, while in the Clyde it is only 9 feet 9 inches: the velocity of the ebb-tide is, on the average, on the Thames 2¾ *miles*, while on the Clyde it is only 2¼ *furlongs*, or little more than one-tenth of the speed. When the sewage of London is run into the Thames at Barking and Crossness, during the first three hours of ebb-tide it passes down the river so far, before the tide flows, that it cannot return. This would not be the case in the Clyde, with its small range of tide and sluggish current; and if, therefore, the sewage of Glasgow is to be introduced into the Clyde, it must first be purified either by irrigation or precipitation.

The second method of dealing with sewage is to use it in the irrigation of land, and this system has the double advantage of purifying the water in a more complete manner than can be attained by any process of chemical treatment, and of utilising, to a certain extent, the manurial value that exists in it. Great hopes were, some years ago, entertained that irrigation was to be the grand solution of the sewage question, and companies obtained from various towns concessions of the sewage for a term of years, as if it were an article possessing an intrinsic value. All that is changed now; some sewage farms, on which immense sums of money have been expended, have been reluctantly abandoned, and irrigation is no longer regarded as anything more than a means of obtaining, where circumstances permit of its application, a good effluent at a moderate outlay. Probably Croydon—a town situated about 12 miles south, or south-east of London—has the most successful of the sewage farms, and it is no small matter to say that it disposes of the sewage of a population of 60,000 persons at an outlay which is now reduced to about £1000 per annum. But the situation of Croydon adapts it in a peculiar degree to the utilisation of its sewage by filtration through land. The quantity of water used in the town per head of population is much less than in Glasgow, and the rainfall not much more than half; no pumping is required, and land is obtained in the immediate vicinity of the town. Again, the land, although not naturally of high quality, is exceedingly well adapted for sewage farming, in consequence of its being of a loose, permeable character, with a bottom of gravel, which acts as a natural drain and prevents any accumulation of the sewage upon the surface of the ground except under very exceptional circumstances. In cold or moderate weather no odours of a distinctly offensive character are given off, but in some sewage farms, during hot weather, the odour is very disagreeable, and possibly unwholesome.

The quantity of land that appears to be necessary, under favourable circumstances, as at Croydon, is about an acre to each 100 of population, so that Glagow with its immediate suburbs would require, at the present time, fully 10 square miles of land, and, including the surrounding burghs, about 12 square miles. The greater part of the sewage would required to be pumped to a considerable height, the land (supposing it were possible to obtain it) would require to be held by the Corporation; and, as experience has shown in the case of the Barking farm, large quantities of certain crops would be obtained, which it would be impossible to dispose of to advantage. Again, it is quite certain that the land occupied could never become residential, or be occupied otherwise than by labourers engaged on the farm. This is even the case at Croydon; although, as already mentioned, the circumstances are there peculiarly favourable to sewage farming.

Purification by chemical treatment has been much misunderstood, and consequently discredited. Because it has not done all that has been claimed for it, some have been inclined to regard it as a failure, and unworthy of consideration. Several processes have been advocated for purifying sewage by precipitation, and at the same time manufacturing from the sludge obtained a manure which will be saleable at a considerable price, under the name of native guano, or some other high-sounding title. The purification of the sewage is possible, and has been carried out successfully at Bradford, Leeds, Coventry, Birmingham, and many other towns; but, so far as I have been able to ascertain, the sale of the so-called manure, except in insignificant quantities, appears to have failed of accomplishment. And this is not to be wondered at, for the precipitant, whatever it may be, while it removes the solid matter of the sewage, together with the phosphoric acid, leaves in the effluent water all or nearly all the ammonia, and the potash salts; these constituting by far the most valuable part of the sewage. All hope of making a profit by the sale of the precipitate or sludge should therefore be abandoned; but that is no reason why the process should not be adopted for the purification of sewage.

The matters removed by lime and by alumina, which are practically the only precipitants that have hitherto been employed, are—

Solid matters,
Phosphoric acid,
Fatty acids of soaps,
Nitrogenous organic matters,
Vegetable colouring matters,
Magnesia.

The soluble nitrogenous compounds and the ammonia in the effluent soon become oxidised, less rapidly in salt than in fresh water; and the oxidation is greatly facilitated by passing the purified sewage through a porous material, with free exposure to the air, or through sandy or gravelly soil.

Of all the substances proposed for precipitation, the one that appears to be most capable of general application is lime. It can be had everywhere, is cheap, and effects a sufficient purification to enable the effluent to be passed into a non-potable running stream or tidal river, especially if the precipitation is supplemented by filtration through some form of charcoal, or by running it over a limited extent of suitable land, thoroughly drained. It has been objected to the lime process that the effluent soon decomposes, while that from other precipitants, being neutral or faintly acid, resists putrefaction for a much longer time. This is quite true, but it appears to me that the fact that the lime effluent readily oxidises is entirely in its favour. The organic matter in the purified sewage *must* be oxidised, and the sooner this is accomplished the less likely is it to produce injurious consequences.

Whatever method of precipitation be adopted, it is most important that the sludge should not remain long in the bottom of the settling tanks; whenever it is permitted to remain for a week or two it ferments, throws up bubbles of the gaseous products of decomposition, and serves to render the effluent offensive—producing, in fact, the very evils so noticeable in the harbour of Glasgow, where the solid portion of the sewage of the city settles down to the bottom, and undergoes putrefactive decomposition. The mud dredged from the Clyde, nearly opposite Lancefield, gave the following results on analysis:—

Water	11·44
Organic matter	12·31
Phosphoric acid	0·80
Sulphuric acid	0·20
Lime	1·32
Magnesia	1·30
Oxide of iron	5·23
Alumina	3·54
Sand, &c.,	63·78
	99·92

Phosphate of lime	1·74
Nitrogen	0·47
Equal to ammonia	0·57
Sulphur in organic matter and combined with iron	0 28
Calculated value, per ton	10/6

If we compare this with the sludge obtained by precipitation we will find that, except for the extra quantity of sand, there is a very striking similarity of composition.

Among the towns where precipitation is in use, none is more worthy of attention than Leicester, the population of which is about 120,000, while the sewage amounts to 7,000,000 gallons per day. It was here that the first attempt was made to purify sewage by precipitation, lime being the agent employed. After 25 years' experience, during which a great many processes were tried, the authorities came back to lime, which they consider the only possible precipitant for the sewage of a large town. The quantity of lime used is 20 to 30 cwt. per million gallons, and nothing is obtained for the sludge, which has hitherto been employed, almost exclusively, in making up land in the immediate neighbourhood of the works. The cost of working, for lime, fuel, and labour, is £2200 per annum. As regards the practical results obtained by the purification of the Leicester sewage, these are not entirely satisfactory, but the conditions existing in the town are altogether exceptional and peculiar. The river Soar, into which the effluent runs, has been canalised, and the flow is said to be only a mile a day in dry weather, while in wet weather it may be ten times as much. Then the effluent forms a very large proportion of the whole contents of the river or canal during dry weather, probably the greater part of it; and above all, there exists in the town a separate system of drains for the rainfall, and all the filth of the streets is washed into the Soar without purification. Lastly, a small low-lying part of the town has, until recently, been kept out of the general drainage system. It is therefore not surprising that, while the bed of the river is kept perfectly clean, and there is no odour perceptible in or near the town, the water four miles down is slightly offensive during dry and hot weather. The sludge, containing about 30 per cent of water, amounts to about 12,000 tons per annum. The whole of the sewage requires to be pumped 26 feet. The precipitation is effected in a series of very large tanks and settling ponds, and the effluent is further purified by filtration through an osier bed three acres in extent.

(To be continued.)

PROCEEDINGS OF SOCIETIES.

AMERICAN CHEMICAL SOCIETY.*

The Annual Meeting was held on December 2, 1880, Vice-President, E. R. Squibb, in the Chair. The following Officers were elected for 1881:—

President—Dr. C. F. Chandler.

Vice-Presidents—A. R. Leeds, E. R. Squibb, Henry Morton, G. A. Kœnig, C. A. Gœpmann.

Corresponding Secretary—P. Casamajor.

Recording Secretary—Albert H. Gallatin.

Treasurer—W. H. Nichols.

Librarian—E. Waller.

Curators—W. Rupp, A. J. Rossi, A. A. Fesquet.

Committee on Papers and Publications—Arno Behr, Gideon E. Moore, A. R. Ledoux.

Committee on Nominations—William Geyer, Jas. H. Stebbins, O. Krause, Arthur H. Elliot, J. C. Battershall.

Board of Directors—A. R. Leeds, E. R. Squibb, Henry Morton (three Local Vice-Presidents), P. Casamajor, Albert H. Gallatin, W. H. Nichols, E. Waller, A. R. Ledoux, C. F. Chandler, H. Endemann, W. M. Habirshaw, M. Alsberg, J. Goldmark.

The following gentlemen were nominated:—As Members—James T. Slade, New York City; Theo. M. Hopke, New York City; A. E. Hoppock, New York City. As Associate Member—E. K. Dunham, School of Mines, New York.

The following papers were read:—

"*On Wilkinson's Process for the Manufacture of Illuminating Gas from Wood*," by Chas. A. Doremus, Ph.D., Adjunct Professor of Chemistry, Bellevue Hospital Medical College, New York. Instead of coal, heated to yield 15,000 cubic feet of gas of low candle power, Virginia pine wood of 3300 lbs. to the cord, costing 5 25 dollars delivered at and piled in the sheds, is heated in "through retorts." After the first charge the resulting charcoal is pushed back in the retort, and the gas made from the second charge is therefore obliged to traverse this bed of red-hot coal. Carbonic dioxide is changed to carbon monoxide, the water in the wood reacts to form water-gas, and a gas results free from tar, acids, &c., and having a composition of:—

Hydrogen	5·40
Marsh-gas	44·16
Carbon monoxide	33·75
Illuminants	none
Carbon dioxide	10·50
Nitrogen	6·00
Oxygen	0·25
Ammonia	none
Sulphuretted hydrogen	none
	100·00

The above is the composition of the crude gas after cooling but before purification.

The average yield during six months was 53,832 cubic feet to the cord. The coke supply for firing being deficient, the furnaces were change so as to burn "pea" anthracite. This was accomplished by using a jet of super-

---

* Communicated by Arthur H. Elliot, F.C.S., Recording Se

heated steam, the superheater being an iron tube running into the fire-pot, and having a central tube to convey the steam to its blind end. The returning steam found its exit through an injector into the fire. An intense heat, capable, however, of nicest regulation, was hereby attained. The air supply is obtained from an iron tube, 2 feet in diameter, open at both ends, and placed above the furnace stacks. The heated air is drawn down to the fire by the steam injector. A saving of 1 dollar per fire per diem is thus effected. Besides these advantages the wood-gas needs very little purification; the spent lime can be re-burnt at the works, the number of hands is largely diminished, and the cleanliness of the process is a notable feature.

To give the wood-gas the requisite illuminating power it is carburetted according to the "binary" process adopted at Buffalo, in 1872. The gas flows into an apparatus provided with shelves, heated by steam pipes, and meets a sheet of naphtha vapourised by the steam. The mixed gas flows from the carburetter to the "fixing retorts and a superheater together. The resulting gas needs only to be sent through a bed of charcoal to cool it and remove some little tar, and is then distributed as commercial gas. The New York Mutual Gas Company now manufacture poor coal- and wood-gas thus carburetted. The commercial gas is composed of :—

Hydrogen and Marsh-gas	56·75
Carbon monoxide..	11·25
Illuminants	15·25
Carbonic dioxide	1·00
Nitrogen	15·00
Oxygen	0·75
Ammonia	—
Sulphuretted hydrogen	—
	100·00

21 volumes of wood-, 37·4 of coal-, and 41·6 of naphtha-gas make 100 of commercial gas. 4·5 gallons naphtha are required to every 1000 cub. ft. commercial gas. This gas has a candle-power of 26·53, has a gravity of 0·703 to 0·808, contains 7·28 grains of sulphur to the 100 cub. ft. (mostly CS_2), and 0·82 grain ammonia per 100 cub. ft. The analyses were made according to Wilkinson's process described in the *London Gas Light Journal*, August, 1877, with a subsequent modification for determining the nitrogen, hydrogen, and marsh-gas, given in the *American Gas Light Journal* for 1879. By this method even hourly variations in the composition of gas can be detected; it is therefore most suitable and convenient for technical purposes. The presence of nitrogen to the amount of 15 per cent, together with a light of 26·53 candle-power, is anomalous; yet the fact is certainly indisputable. The nitrogen gets access from the clay retorts from the fires, as well as by leakage. The retorts are always under exhaust to increase the yield of gas. Poor coal-gas costs 20 cts. (counting the draw-backs) per 1000, while wood-gas only costs 9·9 cts. The Mutual Company send out about 3,000,000 feet of commercial gas daily, 15 per cent being nitrogen, or 450,000 cub. ft. at 2·25 dols. per 1000 (now the ruling price in all N.Y. companies), or 1012·50 dols. profit on nitrogen per diem. The gas does not smoke, is nearly white, is of high gravity, and is constantly increasing in favour.

"*On some New Azo Compounds*," by Jas. H. Stebbins, Jr., B.S. This paper was devoted to a description of some new dyes obtained by the author during the last few months. The first described was Orange No. 3, obtained by diazotising meta-nitraniline and combining one molecule of the diazo-compound so obtained with one molecule of beta-naphthol-disulpho-acid in an alkaline solution. Salt precipitates the dye in a yellow paste, soluble in water, and dyes wool in an acid bath of an orange colour. The reaction is as follows:—

$$C_6H_3 - \overset{3}{N}O_2 - \overset{1}{N} = N - \beta C_{10}H_4(NaSO_3)_2OH.$$

The next compound is Orange No. 4, produced by combining equal molecules of para-diazo-sulpho-xylol and an alkaline solution of resorcin. Hydrochloric acid precipitates the free acid as a red paste, easily soluble in water, and dyeing wool in an acid bath of an old gold colour. The formula of the body is—

$$C_6H_2(CH_3)_2H\overset{4}{S}O_3 - \overset{1}{N} = N - C_6H_3(OH)_2.$$

Parazo-sulphoxyl-naphthaline-α-sulphoxyl-phenol—

$$C_{10}H_6(H\overset{4}{S}O_3) - \overset{1}{N} = N - \alpha C_6H_3(HSO_3)OH,$$

is prepared by combining equal molecules of diazo-naphthionic acid and phenole sulpho-acid in an alkaline solution; the soda salt falls from the free acid by addition of sodium chloride, as a yellow-brown paste, soluble in water.

The next body described was Parazo-dimethyl-sulphoxyl-benzol α-naphthol—

$$C_6H_2(CH_3)_2(H\overset{1}{S}O_3) \overset{:}{-} \overset{4}{N} = N - \alpha C_{10}H_6OH,$$

which is a brown dye, prepared by combining para-diazo-sulpho-xylol with an alkaline solution of α-naphthol. Hydrochloric acid gives a brown flocculent precipitate, soluble in water.

Para-diazo-sulphoxyl-β-naphthol—

$$C_6H_2(CH_3)_2(H\overset{4}{S}O_3) \overset{:}{-} \overset{1}{N} = N - \beta C_{10}H_6OH,$$

is formed as a scarlet precipitate when equal molecules of para-diazo-sulpho-xylol and β-naphthol are mixed together in an alkaline solution. The author described the soda and silver salts of this body.

The author then described Metazo-nitro-benzol-α-naphthol—

$$C_6H_4\overset{3}{N}O_2 \overset{:}{-} \overset{1}{N} = N - \alpha C_{10}H_6OH,$$

produced by treating diazo-meta-nitro-benzol with an alkaline solution of α-naphthol. It is a red-brown body, soluble in water.

Also Parazo-sulphoxyl-xylol-β-phenanthrol—

$$C_6H_2(CH_3)_2(H\overset{4}{S}O_3) \overset{:}{-} \overset{1}{N} = N - \beta C_{14}H_8OH,$$

prepared by treating para-diazo-sulpho-xylol, with an alkaline solution of β-phenanthrol.

Parazo-sulphoxyl-xylol-α-dibrom-naphthol—

$$C_6H_2(CH_3)_2(H\overset{4}{S}O_3) \overset{:}{-} \overset{1}{N} = N - \alpha C_{10}H_4(Br_2)OH,$$

was prepared by treating one molecule of para-diazo-sulphoxyl with one molecule of α-dibrom-naphthol dissolved in an alkaline solution. Soluble in hot water.

Azo-dinitro-oxy-benzole-paramido-sulphoxyl-naphthalin is produced by combining equal molecules of diazo-dinitro-phenol with an alkaline solution of naphthionic acid.

Parazo-sulphoxyl-naphthalin-β-naphthol-disulpho-acid, $C_{10}H_6(HSO_3) - N = N - \beta C_{10}H_4(HSO_3)_2OH$, by the reaction of equal molecules of diazo-naphthionic acid and β-naphthol-disulpho-acid; it is a crimson dye, soluble in water.

The following papers were read by title, and referred to the Committee on Publications:—

"On Para- and Ortho-tolyl-sulpho-urethan," by C. Liebermann and S. Natanson.

"On Compounds of Anthracen with Different Oxides of Nitrogen," by C. Liebermann and L. Lindermann.

"On the Composition of Æsculine and Æsculetine," by C. Liebermann and R. Kneitsch.

"Investigations on the Reduction of Anthraquinone," by C. Liebermann.

"On the Electrolytic Determination of Silver," by H. Fresenius and F. Bergmann.

"On the Electrolytic Determination of Nickel and Cobalt," by H. Fresenius and F. Bergmann.

"On Cyanethine and New Bases Derived therefrom," by Ernst von Meyer.

CORRESPONDENCE.

BLEACHING-POWDER.

To the Editor of the Chemical News.

Sir,—The reply given by Dr. Lunge to my previous letter makes it necessary for me—with your permission—to enter a little more into the details of the subject in question.

On reading Dr. Lunge's paper, printed in the Chemical News (vol. xliii., p. 1), it occurred to me that the author should have treated of the existence of calcic hypochlorite in solutions of "bleach" rather as an ascertained fact than as a mere assumption made by most chemists; and as I had previously isolated the crystallised hypochlorite from such solutions, I felt that such a treatment of the matter was due to me, apart from the manner in which my experiments affect the views regarding the constitution of bleaching-powder.

I entertain a great respect for the opinions of Dr. Lunge, but I object to the manner in which he refers to the particular investigation alluded to previously. That the solutions of bleaching-powder examined by me contained and yielded calcic hypochlorite is not merely my opinion, but is an absolutely proven fact. Specimens of the crystallised salt were exhibited at the Chemical Society, and the details of the analytical methods employed, together with the results obtained, are stated in my paper (*Journ. Chem. Soc.*, May, 1875). Subsequently, a further quantity, nearly a pound by weight, of the calcic hypochlorite was obtained from another sample of bleaching-powder, and some of this, changed though it may be, is still in my laboratory. It is true that in my paper I expressed the desirability of other chemists repeating the observations upon further samples of bleaching-powder, but I made no apology for such observations as I had recorded, and I make no apology now. The expression referred to neither detracted from the force of my convictions nor prejudiced in any way the fact that different samples of bleaching-powder examined by me yielded in contact with water calcic hypochlorite which was crystallised out of the aqueous solutions.

The doubt that was really in my mind was clearly stated in the Chemical News, when my paper was reprinted therein with some additional notes (vol. xxxii., p. 22), and concerned the possibility of the non-identity of the crystals which sometimes form in frozen solutions of bleach with those obtained as otherwise described, and which alone had been analysed.

That Dr. Lunge has failed to obtain calcic hypochlorite by repeating my observations seems strange to me, because the proceedings are so simple, and I can assure him that there are no such conditions to be observed as hinted at by him. Will he kindly state for how long he allowed the bleach solutions to remain *in vacuo* over sulphuric acid and caustic potash, and will he have the goodness to favour me with a small quantity of the "bleach" from which he failed to obtain the crystals? This concerns an important matter, and it is one which deserves to be thoroughly worked out.

A few words, now, as regards the other point in this discussion. As I read the history of bleaching-powder, taking note of all recorded observations, chemists are forced to choose between Gay-Lussac's and Odling's formulæ. The former of these assumes the co-existence of calcic hypochlorite and calcic chloride in bleaching-powder, but since the last-named substance cannot be separated therefrom, there is no reliable ground for belief in its correctness. If Odling's formula represents "bleach" as the unitary compound Cl—Ca—OCl; and if bleaching-powder suffers decomposition in a state of aqueous solution at all, I fail to see how else it can split up than into hypochlorite and chloride. That this decomposition occurs has been assumed by most chemists for a long time, and the proof of the decomposition was furnished by my investigation. I therefore abide by what is stated in my "Alkali Trade," p. 182, viz., that "the combination

$$\left(Ca\begin{cases}Cl\\OCl\end{cases}\right)$$

is so feeble that under certain conditions water destroys the compound from a chemical whole into the two salts." Incidentally proof is furnished of the correctness of Odling's formula; and if further corroboration be needed I think it would be most easily found in the study of the action of dilute acids upon solutions of bleaching-powder, and in the further study of the action of chlorine upon milk of lime.—I am, &c.,

C. T. Kingzett.

12, Auriol Road, West Kensington, W.,
January 29, 1881.

SOCIETY OF INDUSTRIAL CHEMISTS.

To the Editor of the Chemical News.

Sir,—Will you kindly allow me to ask through your columns, what has become of the projected Technical Society? (*Vide* Chemical News, vol. xli., pp. 243 and 261). Has the comittee given up the idea? If so, it devolves upon those directly interested in the scheme to see that it is not allowed to fall into oblivion. Surely there are technical chemists enough to render such an amount of support as to ensure success to such an undertaking.

Trusting soon to receive some information as to what has been the result of the committee's investigations,—I am, &c.

J. H.

January 29, 1881.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, l'Académie des Sciences. No. 1, January 3, 1880.

Magnetic Oxide of Iron.—M. Berthelot.—The author has determined the formation-heat of the most soluble variety of the magnetic oxide of iron. He finds that the heat liberated on the combination of the two primary oxides of iron, the ferrous and ferric, amounts to 4·4 cals.

Measurement of the Electromotor Force of Batteries.—J. B. Baille.—The following numbers represent the potential of an element of the battery, that is to say, the quantity of electricity which the pole of this battery diffuses in a sphere of 0·01 m. radius. They are expressed in electric unities, the unity being the quantity of electricity which, reacting upon itself at the distance of 0·01 m., produces a repulsion = 1 grm. Volta's battery, 0·03415; zinc, copper sulphate, copper, 0·02997; zinc, acidulated water, copper, copper sulphate, 0·03709; zinc, salt-water, coke, manganese peroxide, 0·05282; zinc, salt-water, platinum, platinum chloride, 0·05027; zinc, acidulated water, coke, nitric acid, 0·06285. These figures are the maximum values obtained at the moment when the battery is charged, but these potentials diminish rapidly with time.

Speed of Light.—Reply to M. Cornu.—M. Gouy.—Not suitable for abstraction.

Study on Spectro-photometers.—A. Crova.—The comparison of two spectra coming from two different sources of light is easily effected by covering the half of the slit of a photometric spectroscope with a small rectangular prism, the edge of which cuts the slit normally into two equal parts; one of its halves receives one of the lights directly, whilst the other receives by reflection the other light placed laterally. In this case the slit should be horizontal, and if the prisms are well cut and free from aberration, we obtain at once the distinct image of the spectral rays and that of the edge of the prism, which appears as a fine line, separating from each other the two spectra to be compared.

Process for Reproducing Words with Electric Condensers, and especially with the Singing Condenser.—A. Dunand.—In order to make a condenser sing it is merely needful to connect its armatures with the extremities of the secondary helix of an induction-coil, interposing in the primary helix a battery and a microphone analogous to the transmitter of Reiss. If thus arranged the apparatus merely reproduces musical sounds. The author interposed a battery in the secondary helix of the coil, *i.e.*, he connected one extremity of the induced wire with one of the poles of a battery, the other pole communicating with one armature of the condenser, the second armature being attached to the other extremity of the induced wire. Articulate sounds are then reproduced with perfect distinctness. M. Th. du Moncel observed that this fact confirms his ideas on the origin of sounds in the telephone.

Vapour-Density of Iodine.—J. M. Crafts and F. Meier.—The authors remark that at a low temperature, *e.g.*, at 355° the vapours of iodine have the same coefficient of expansion and compressibility as the air. The variation of the density with rising temperature increases rapidly and then decreases, becoming *nil* at the highest temperatures. With low tensions the vapour-density becomes constant again between 1400° to 1520°, and equal to the half of the normal density. The softening of the porcelain by heat prevented the authors from carrying this investigation to a conclusion in the case of higher pressures. As regards theoretical conclusions, all the facts agree with the hypothesis already advanced that iodine may exist at low temperatures in the molecular state, I_2, and at higher temperatures in the atomic state, I, the variations of density with temperature and pressure corresponding with a dissociation which progresses according to laws often observed. When we come to the question of the dissociation of a molecule into homogeneous atoms we cannot employ the methods of demonstration which M. Sainte-Claire Deville made use of, and it must be admitted that absolute proof is wanting. But we cannot fail to recognise that all the phenomena take place as if a dissociation took place, and this hypothesis seems to us to offer the sole explanation of the curious fact that the two limits correspond with two simple and well-defined chemical proportions, I_2 and I. The effect of a decrease of tension in facilitating dissociation is well-known. M. Salet has observed that the colour of the vapours of iodine becomes much less intense at high temperatures. The authors hope that their researches may furnish a numerical basis of the speculations on the decomposition of the elements which have been founded on spectroscopic observations.

Direct Preparation of the Chloro- and Bromo-Compounds of the Methylic Series, and Especially of Chloroform and Bromoform.—M. Alb. Damoiseau.—The author allows a regular current of chlorine, furnished by a continuous apparatus, to mix in suitable proportions with methyl-chloride, and then to traverse a long tube containing animal charcoal and heated to 250° to 350°. The gases are washed with water to remove hydrochloric acid and refrigerated. In this manner many hundred grammes of chloroform may be prepared.

Facts Towards the Study of the Formation of Fog.—M. Ch. André.—The author records an observation made at Mount Verdun, on Nov. 8 last. During the day the barometer was high, the temperature about 0°, and the wind blew with a feeble mean pressure. An intense fog covered the table-land of Verdun, occasionally dispersing to reappear after a short interval. The barometer fell whenever rain set in, but the fall was always sudden and generally accompanied by the dispersal of the fog. The rise was more gradual and was accompanied by the reappearance of the fog.

A New Use of Electricity.—M. O. F. Grandt.—The author has constructed an apparatus for giving movement to ships. An ordinary steam-engine sets in action one or more electro-dynamic induction machines. The current is transmitted to a voltameter containing acidulated water which is decomposed into oxygen and hydrogen. These gases are conducted into a tube and escape by an aperture near the keel. A little above this aperture there are two platinum points isolated from each other and in communication with a Ruhmkorff's induction coil. When the gas escapes, a spark explodes it, and this explosion moves the ship.

Journal de Pharmacie et de Chimie.
August, 1880.

Curare of English Guiana.—G. Planchon.—A conclusion of the papers on the strychnos.

Absence of Mercury in the Mineral Waters of the Springs of Rocher and Saint Nectaire.—J. Lefort.—A lengthy paper, of doubtful scientific importance.

Wines made from Dry Grapes.—M. Reboul.—There is no absolute chemical distinction between natural wines and those made from raisins.

Report Submitted by M. Riche to the Academy of Medicine on the Substitution of Margarine for Butter and Lard in the Public Asylums of the Department of the Seine.—The author concludes that there are no grounds for the substitution of margarine for butter.

Preparation of Malonic Acid.—E. Bourgoin.

Synthesis of Citric Acid.—E. Grimaux and P. Adam.

Detection and Determination of Heavy Mineral Oils, Fatty Oils, and Resin in the Oils of Commerce (Second part).—A. Semont.—These three papers have been already noticed.

Die Chemische Industrie.
No. 7, July, 1880.

The German Alkali Trade in 1880.—R. Hasenclever.—This memoir is rather commercial and protectionist than technological. He expects that the importation of foreign soda into Germany will soon cease, and that over-production will set in. He then criticises some of the recent improvements described in Dr. Lunge's work.

Analyses of Leblanc's Crude Soda and of Soda-lyes in Different Stages of Preparation.—Dr. K. W. Jurische.—The writer maintains that the quantity of the cyanogen compounds depends simply on the quantity of undecomposed sulphate present. The advantage of the Pechiney-Weldon process is chiefly in the circumstance that a product is always obtained containing approximately the same proportion of undecomposed sulphate, which is sufficient to keep down the cyanides to the proportion which occurs in hand-made lyes.

No. 8, August, 1880.

Colorimetric Determination of Chlorine in Potassium Bromide.—Dr. Carl Roth.—If potassium bromide containing chlorine is distilled with sulphuric acid and potassium chromate and the chromium oxychloride evolved is passed into water containing ammonia, it is known to be resolved into ammonium chloride, water, and ammonium chromate. Since the dilute solutions of neutral ammonium chromate display very decided differences in intensity of colour, there is here the possibility of using this colour to indicate the percentage of chlorine in the potassium bromide. For this purpose exactly 1 grm. potassium bromide is ground up to a powder with approximately the same quantity of potassium bichromate, and the mixture is introduced without loss into a small flask, where it is drenched with about 5 c.c. concentrated sulphuric acid. The flask is then connected by means of a tube ground so as to fit air-tight with a receiver containing 50 c.c. of very dilute ammonia. All the chlorine is driven over by the application of a gentle heat as chromium oxychloride, which is decomposed on entering the receiver in the ordinary manner. A regurgitation of the ammoniacal liquid into the flask is prevented by means of two balls blown on the connecting tube. After the completion of the operation the contents of the receiver are introduced into a measuring cylinder, and diluted with water to 100 c.c. For comparison, there are used solutions of neutral ammonium chromate of known strength; 152 parts of ammonium chromate correspond to 71 parts of chlorine. If we suppose a maximum quantity of chlorine as 5 per cent, or 0·107 grm. in 1 grm. potassium bromide, there follows from the proportion $71 : 152 = 0{\cdot}05 : x = 0{\cdot}107$ grm. ammonium chromate, which must be dissolved in 100 c.c. water in order to obtain a colour representing 5 per cent. In a similar manner solutions may be prepared representing smaller proportions.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin.

No. 6, 1880.

New Electrolytic Results.—E. F. Smith.—On passing the current from a potassium chromate battery of two elements through an aqueous solution of uranium acetate, bright yellow uranium sesquioxide was separated at the zinc pole and gradually turned black. No uranium remained in the solution. The most favourable results were obtained on dissolving 1000 grms. of a salt of uranium in 10 c.c. water. The complete precipitation of the uranium and its conversion into the black form requires three hours. The black compound is uranic uranous oxide, containing 81·13 per cent of metallic uranium. This process is well adapted for the analysis of the uranium silicates. Ammonium molybdate is precipitated by the current, but the process requires many hours for its completion. Neutral solutions of tungstates are not affected by the current. If boiled with acetic acid there is produced a small quantity of a blue precipitate, which turns brown on prolonged action, but becomes blue again on exposure to the air. In solutions of the vanadiates the current produces only a change of colour. Vanadium sulphate yields a deposit of small, deep brown flakes. Didymium is imperfectly precipitated at the positive pole. From the salts of cerium the yellow Ce_3O_4 hydrate is thrown down, incompletely and slowly.

The Colouring-Matter of Alkanet (Anchusa tinctoria) as a Reagent for Magnesium Salts.—F. v. Lepel.

Vegetable Colouring-Matters as Reagents for Magnesium Salts.—F. v. Lepel.—These two papers require the accompanying diagrams.

An Acoustic Method of Determining Vapour-Densities.—H. Goldschmiedt.

A New Apparatus for the Volumetric Determination of Nitrogen.—H. Schwarz.—These two memoirs cannot be usefully reproduced without the accompanying illustrations.

Bulletin de la Société Chimique de Paris.

No. 1, July 20, 1880.

Density of the Vapour of Iodine.—J. M. Crafts and F. Meier.—In this paper, which is a continuation from pp. 501 and 550 of vol. 33, the authors describe their method for the determination of the temperatures which they communicated to the Academy of Sciences (March 15, 1880), and which is the same as that employed by Prof. Meyer in his recent investigation on gaseous chlorine.

Certain Compounds of the Halogens.—M. Berthelot.—A thermo-chemical paper, already noticed.

Separation of Cadmium and Zinc.—A. Yver.—In a memoir inserted in the *Annales de Chimie et de Physique* (Series 4, vol. 30, p. 351), M. Riche described a process for the determination of zinc, either by the decomposition of the acetate or by the electrolysis of the solution containing sulphuric acid. Several researches on the same subject have since been published by different authors. MM. Beilstein and Jawein, whilst confirming the results of Riche, employ the following process:—The nitric or sulphuric solution of zinc is mixed with caustic soda until precipitation ensues, and then with potassium cyanide till the precipitate is re-dissolved; the electrolysis is then effected with four Bunsen elements. The determination of cadmium has been effected by the same chemists under the same circumstances by means of the current from three elements. M. Millot has recently given a process for the determination of zinc by the electrolysis of a solution of this metal in potassa. M. Edgar Smith obtains a precipitate of metallic cadmium by passing a strong current through a solution of the acetate. These procedures have the defect of not serving for the separation of cadmium and zinc, as the two metals are precipitated simultaneously. They may be separated as follows:—The solution containing the two metals in the state of acetates is mixed with 2 or 3 grms. sodium acetate, and a few drops of acetic acid. The current from two Daniell elements is then passed through the solution as described by M. Riche in his memoir. The cadmium alone is deposited in a crystalline layer at the negative pole, the zinc remaining in solution. The process requires the aid of heat, and requires three to four hours for quantities of 0·180 grm. to 0·210 grm. cadmium, and as much zinc. The deposit is effected in the crucible, and the liquid is then drawn off and serves for the determination of the zinc, according to M. Riche's process. The deposit is washed first with water, then with alcohol, dried, and weighed. If the zinc and cadmium are present as sulphates the author recommends precisely the same method. Or the sulphuric solution may be mixed with ammonia and ammonium sulphate.

Reproduction of Analcime.—A. de Schulten.—Already noticed.

Compounds of Uranium with the Alkaline Pyrophosphates and Meta-phosphates.—P. Chastaing.—Not capable of useful abstraction.

Sodium Boro-tungstates.—D. Klein.—The author adds small successive portions of tungstic acid to a boiling solution of borax. On cooling boracic acid and sodium, poly-borates crystallise out, and on concentration the mother-liquor deposits sodium boro-tungstate in bacillary crystals, soluble in one-fourth their weight of water, and which may be represented by the formula—

$$10WO_3,Bo_2O_3,2Na_2O + 11aq.$$

Preparation of Sulphuric Ether.—A. Villiers.—Already noticed.

Preparation of Hydrochloric Ether.—A. Villiers.—The author passes hydrochloric gas into boiling absolute alcohol contained in a flask fitted with an ascending refrigerator.

Formation of the Bromised Derivatives of Ethyl Bromide in the Preparation of Hydrobromic Ether.—A. Bertrand and E. Finot.—The authors have obtained a bromised ethyl bromide boiling at 110°, another boiling at 180°, and a dibromised ethylene dibromide boiling at 195° to 200°.

Dichloro-lactic Acid.—E. Grimaux and P. Adam.—This compound is obtained by the action of hydrocyanic and hydrochloric acids upon dichloric aldehyd. It forms transparent laminæ, fusible at 76·5° to 77°; very soluble in water, alcohol, and ether, of the composition—

$$C_3H_4Cl_2O_3.$$

Tetric and Oxy-tetric Acids and their Homologues (Concluded from pp. 516 and 575).—E. Demarçay.—Not suitable for abstraction.

MISCELLANEOUS.

Sanitary Institute of Great Britain.—At a meeting of the Sanitary Institute of Great Britian, held January 27, B. W. Richardson, M.D., F.R.S., in the chair, the Secretary read a list of books presented to the library since last meeting, and one Fellow and two Members were elected.

MEETINGS FOR THE WEEK.

MONDAY, 7th.—London Institution, 5.
—— Medical, 8.30.
—— Royal Institution, General Monthly Meeting, 5.
—— Society of Arts, 8. "Watchmaking," by Edward Rigg, M.A.
TUESDAY, 8th.—Royal Institution, 3 p.m. "The Blood," Prof. Schäfer.
—— Civil Engineers, 8.
—— Medical and Chirurgical, 8.30.
WEDNESDAY, 9th.—Society of Arts, 8. "The Present Condition of the Art of Wood-carving in England," J. Hungerford Pollen.
—— Microscopical, 8. (Anniversary), 9.
—— Royal Institution, 3. "The Amazons," Prof. S. Colvin.
THURSDAY, 10th.—London Institution, 7.
—— Royal, 4.30.
—— Royal Society Club, 6.30.
—— Mathematical, 8.
—— Royal Institution, 3. "The Troubadours," Mr. F. Hueffer.
FRIDAY, 11th.—Royal Institution, 8. "Distance of the Stars," Prof. R. S. Ball, 9.
—— Quekett, 8.
—— Society of Arts, 8. "The Gold Fields of India," Hyde Clarke.
SATURDAY, 12th.—Royal Institution, 3. "The Amazons," Prof. S, Colvin.
—— Physical, 3. Annual General Meeting. Special General Meeting. "On a Hydrostatic Illustration of Electrical Phenomena and other Lecture Experiments," Dr. O. J. Lodge.

TO CORRESPONDENTS.

A.C.D.—The first volume of Dr. Lunge's work contains what you want.

THE CHEMICAL NEWS
AND
JOURNAL OF PHYSICAL SCIENCE.

Edited by WILLIAM CROOKES, F.R.S.

Published every Friday. Price 4d. Annual Subscription, post free including Indices, £1

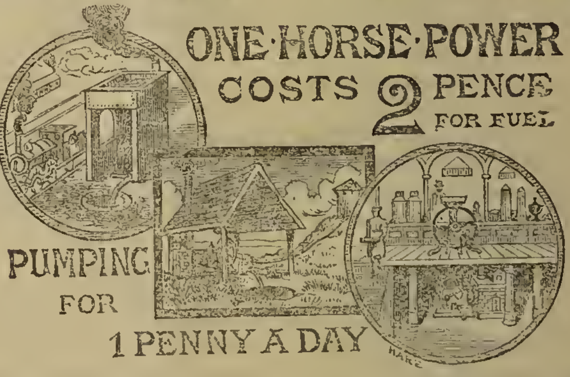
CHARGES FOR ADVERTISEMENTS.

	£	s.	d.
Five lines in column (about 10 words to line)	0	3	6
Each additional line	0	0	6
Whole column	1	15	0
Whole page	3	0	0

A reduction made for a series of insertions.

Cheques and Post-Office Orders, crossed "London and County Bank," payable to the order of William Crookes.

BOY COURT, LUDGATE HILL, LONDON, E.C.



THE CHEMICAL NEWS.

Vol. XLIII. No. 1107.

ACTION OF AN INTERMITTENT BEAM OF RADIANT HEAT UPON GASEOUS MATTER.*

By JOHN TYNDALL, F.R.S.

The Royal Society has already done me the honour of publishing a long series of memoirs on the interaction of radiant heat and gaseous matter. These memoirs did not escape criticism. Distinguished men, among whom the late Prof. Magnus and the late Prof. Buff may be more specially mentioned, examined my experiments, and arrived at results different from mine. Living workers of merit have also taken up the question: the latest of whom,† while justly recognising the extreme difficulty of the subject, and while verifying, so far as their experiments reach, what I had published regarding dry gases, find me to have fallen into what they consider grave errors in my treatment of vapours.

None of these investigators appear to me to have realised the true strength of my position in its relation to the objects I had in view. Occupied for the most part with details, they have failed to recognise the stringency of my work as a whole, and have not taken into account the independent support rendered by the various parts of the investigation to each other. They thus ignore verifications, both general and special, which are to me of conclusive force. Nevertheless, thinking it due to them and me to submit the questions at issue to a fresh examination, I resumed, some time ago, the threads of the inquiry. The results shall, in due time, be communicated to the Royal Society; but, meanwhile, I would ask permission to bring to the notice of the Fellows a novel mode of testing the relations of radiant heat to gaseous matter, whereby singularly instructive effects have been obtained.

After working for some time with the thermopile, it occurred to me several weeks ago that the results thus obtained might be made evident by a more direct and simple form of experiment. Placing the gases and vapours in diathermanous bulbs, and exposing the bulbs to the action of radiant heat, the heat absorbed by different gases and vapours ought, I consider, to be rendered evident by ordinary expansion. I devised an apparatus with a view of testing this idea. But, at this point, and before my proposed gas-thermometer was constructed, I became aquainted with the ingenious and original experiments of Mr. Graham Bell, wherein musical sounds are obtained through the action of an intermittent beam of light upon solid bodies.

From the first, I entertained the opinion that these singular sounds were caused by rapid changes of temperature producing corresponding changes of shape and volume in the bodies impinged upon by the beam. But if this be the case, and if gases and vapours really absorb radiant heat, they ought to produce sounds more intense than those obtainable from solids. I pictured every stroke of the beam responded to by a sudden expansion of the absorbent gas, and concluded that when the pulses thus excited followed each other with sufficient rapidity, a musical note must be the result. It seemed plain, moreover, that by this new method many of my previous results might be brought to an independent test. Highly diathermanous bodies, I reasoned, would produce faint sounds, while highly athermanous bodies would produce loud sounds; the strength of the sound being, in a sense, a measure of the absorption. The first experiment made, with a view of testing this idea, was executed in the presence of Mr. Graham Bell;* and the result was in exact accordance with what I had foreseen.

The inquiry has been recently extended so as to embrace most of the gases and vapours employed in my former researches. My first source of rays was a Siemens lamp connected with a dynamo-machine, worked by a gas engine. A glass lens was used to concentrate the rays, and afterwards two lenses. By the first the rays were rendered parallel, while the second caused them to converge to a point about 7 inches distant from the lens. A circle of sheet zinc provided first with radial slits and afterwards with teeth, cut through it, was mounted vertically on a whirling table, and caused to rotate rapidly across the beam near the focus. The passage of the slits produced the desired intermittence,† while a flask containing the gas or vapour to be examined received the shocks of the beam immediately behind the rotating disk. From the flask a tube of india-rubber, ending in a tapering one of ivory or box wood, led to the ear, which was thus rendered keenly sensitive to any sound generated within the flask. Compared with the beautiful apparatus of Mr. Graham Bell, the arrangement here described is rude; it is, however, very effective.

With this arrangement the number of sounding gases and vapours was rapidly increased. But I was soon made aware that the glass lenses withdrew from the beam its most effectual rays. The silvered mirrors employed in my previous researches were therefore invoked; and with them, acting sometimes singly and sometimes as conjugate mirrors, the curious and striking results which I have now the honour to submit to the Society were obtained.

Sulphuric ether, formic ether, and acetic ether being placed in bulbous flasks,‡ their vapours were soon diffused in the air above the liquid. On placing these flasks, whose bottoms only were covered by the liquid, behind the rotating disk, so that the intermittent beam passed through the vapour, loud musical tones were in each case obtained. These are known to be the most highly absorbent vapours which my experiments revealed. Chloroform and bisulphide of carbon, on the other hand, are known to be the least absorbent, the latter standing near the head of diathermanous vapours. The sounds extracted from these two substances were usually weak and sometimes barely audible, being more feeble with the bisulphide than with the chloroform. With regard to the vapours of amylene, iodide of ethyl, iodide of methyl and benzol, other things being equal, their power to produce musical tones appeared to be accurately expressed by their ability to absorb radiant heat.

It is the vapour, and not the liquid, that is effective in producing the sounds. Taking, for example, the bottles in which my volatile substances are habitually kept, I permitted the intermittent beam to impinge upon the liquid in each of them. No sound was in any case produced, while the moment the vapour-laden space above an active liquid was traversed by the beam, musical tones made themselves audible.

A rock-salt cell filled entirely with a volatile liquid, and subjected to the intermittent beam, produced no sound. This cell was circular and closed at the top. Once, while

---

* A paper read before the Royal Society, January 13, 1881.

† MM. Lecher and Pernter, *Philosophical Magazine*, January, 1881. *Sitzb. der K. Akad. der Wissensch. in Wein*, July, 1880.

* On the 29th November: see *Journal of the Society of Telegraph Engineers*, December 8, 1880.

† When the disk rotates the individual slits disappear, forming a hazy zone through which objects are visible. Throwing by the clean hand, or better still by white paper, the beam back upon the disk, it appears to stand still, the slits forming so many dark rectangles. The reason is obvious, but the experiment is a very beautiful one.

I may add that when I stand with open eyes in the flashing beam, at at a definite velocity of recurrence, subjective colours of extraordinary gorgeousness are produced. With slower or quicker rates of rotation the colours disappear. The flashes also produce a giddiness sometimes intense enough to cause me to grasp the table to keep myself erect.

‡ I have employed flasks measuring from 8 inches to $\frac{3}{8}$ths of an inch in diameter. The smallest flask, which had a stem with abore of about $\frac{1}{8}$th of an inch in diameter, yielded better effects than the largest. Flasks from 2 to 3 inches in diameter, yield good results. Ordinary test-tubes also answer well.

operating with a highly athermanous substance, a distinct musical note was heard. On examining the cell, however, a small bubble was found at its top. The bubble was less than a quarter of an inch in diameter, but still sufficient to produce audible sounds. When the cell was completely filled, the sounds disappeared.

It is hardly necessary to state that the pitch of the note obtained in each case is determined by the velocity of rotation. It is the same as that produced by blowing against the rotating disk and allowing its slits to acts like the perforations of a syren.

Thus, as regards vapours, prevision has been justified by experiment. I know turn to gases. A small flask, after having been heated in the spirit-lamp so as to detach all moisture from its sides, was carefully filled with dried air. Placed in the intermittent beam it yielded a musical note, but so feeble as to be heard only with attention. Dry oxygen and hydrogen behaved like dry air. This agrees with my former experiments, which assigned a hardly sensible absorption to these gases. When the dry air was displaced by carbonic acid, the sound was far louder than that obtained from any of the elementary gases. When the carbonic acid was displaced by nitrous oxide, the sound was much more forcible still, and when the nitrous oxide was displaced by olefiant gas it gave birth to a musical note, which when the beam was in good condition, and the bulb well chosen, seemed as loud as that of an ordinary organ pipe.[*] We have here the exact order in which my former experiments proved these gases to stand as absorbers of radiant heat. The amount of the absorption and the intensity of the sound go hand in hand.

A soap bubble blown with nitrous oxide, or olefiant gas, and exposed to the intermittent beam, produced no sound, no matter how its size might be varied. The pulses obviously expended themselves upon the flexible envelope, which transferred them to the air outside.

But a film thus impressionable to impulses on its interior surface, must prove at least equally sensible to sonorous waves impinging on it from without. Hence, I inferred, the eminent suitability of soap bubbles for sound lenses. Placing a "sensitive flame" some feet distant from a small sounding reed, the pressure was so arranged that the flame burnt tranquilly. A bubble of nitrous oxide (sp. gr. 1·527) was then blown, and placed in front of the reed. The flame immediately fell and roared, and continued agitated as long as the lens remained in position. A pendulous motion could be imparted to the bubble so as to cause it to pass to and fro in front of the reed. The flame responded, by alternately roaring and becoming tranquil, to every swing of the bubble. Nitrous oxide is far better for this experiment than carbonic acid, which speedily ruins its envelope.

The pressure was altered so as to throw the flame, when the reed sounded, into violent agitation. A bubble blown with hydrogen (sp. gr. 0·069) being placed in front of the reed, the flame was immediately stilled. The ear answers instead of the flame.

In 1859 I proved gaseous ammonia to be extremely impervious to radiant heat. My interest in its deportment when subjected to this novel test was therefore great. Placing a small quantity of liquid ammonia in one of the flasks, and warming the liquid slightly, the intermittent beam was sent through the space above the liquid. A loud musical note was immediately produced. By the proper application of heat to a liquid the sounds may be always intensified. The ordinary temperature, however, suffices in all the cases thus far referred to.

In this relation the vapour of water was that which interested me most, and as I could not hope that at ordinary temperatures it existed in sufficient amount to produce audible tones, I heated a small quantity of water in a flask almost up to its boiling-point. Placed in the intermittent beam, I heard—I avow with delight—a powerful musical sound produced by the aqueous vapour.

Small wreaths of haze, produced by the partial condensation of the vapour in the upper and cooler air of the flask, were, however, visible in this experiment; and it was necessary to prove that this haze was not the cause of the sound. The flask was, therefore, heated by a spirit-flame beyond the temperature of boiling water. The closest scrutiny by a condensed beam of light then revealed no trace of cloudiness above the liquid. From the perfectly invisible vapour, however, the musical sound issued, if anything, more forcible than before. I placed the flask in cold water until its temperature was reduced from about 90° to 10° C., fully expecting that the sound would vanish at this temperature; but, notwithstanding the tenuity of the vapour, the sound extracted from it was not only distinct but loud.

Three empty flasks, filled with ordinary air, were placed in a freezing mixture for a quarter of an hour. On being rapidly transferred to the intermittent beam, sounds much louder than those obtainable from dry air were produced.

Warming these flasks in the flame of a spirit-lamp until all visible humidity had been removed, and afterwards urging dried air through them, on being placed in the intermittent beam the sound in each case was found to have fallen almost to silence.

Sending, by means of a glass tube, a puff of breath from the lungs into a dried flask, the power of emitting sound was immediately restored.

When, instead of breathing into a dry flask, the common air of the laboratory was urged through it, the sounds became immediately intensified. I was by no means prepared for the extraordinary delicacy of this new method of testing the athermancy and diathermancy of gases and vapours, and it cannot be otherwise than satisfactory to me to find that particular vapour, whose alleged deportment towards radiant heat has been so strenuously denied, affirming thus audibly its true character.

After what has been stated regarding aqueous vapour, we are prepared for the fact that an exceedingly small percentage of any highly athermanous gas diffused in air suffices to exalt the sounds. An accidental observation will illustrate this point. A flask was filled with coal-gas and held bottom upwards in the intermittent beam. The sounds produced were of a force corresponding to the known absorptive energy of coal-gas. The flask was then placed upright, with its mouth open, upon a table, and permitted to remain there for nearly an hour. On being restored to the beam the sounds produced were far louder than those which could be obtained from common air.[*]

Transferring a small flask or a test-tube from a cold place to the intermittent beam, it is sometimes found to be practically silent for a moment, after which the sounds become distinctly audible. This I take to be due to the vapourisation by the calorific beam of the thin film of moisture adherent to the glass.

My previous experiments having satisfied me of the generality of the rule that volatile liquids and their vapours absorb the same rays, I thought it probable that the introduction of a thin layer of a liquid, from which even a most energetic vapour was derived, would detach the effective rays, and thus quench the sounds. The experiment was made, and the conclusion verified. A layer of water, formic ether, sulphuric ether, or acetic ether, one-eighth of an inch in thickness, rendered the transmitted beam powerless to produce any musical sound. These liquids being transparent to light, the efficient rays which they intercepted must have been those of obscure heat.

A layer of bisulphide of carbon about ten times the thickness of the transparent layers just referred to, and rendered opaque to light by dissolved iodine, was interposed in the path of the intermittent beam. It produced hardly any diminution of the sounds of the more active

---

[*] With conjugate mirrors the sounds with olefiant gas are readily obtained at a distance of twenty yards from the lamp. I hope to be able to make a candle flame effective in these experiments.

[*] The method here described is, I doubt not, applicable to the detection of extremely small quantities of fire-damp in mines.

vapours—a further proof that it is the invisible heat rays, to which the solution of iodine is so eminently transparent, that are here effectual.

Converting one of the small flasks used in the foregoing experiments into a thermometer bulb, and filling it with various gases in succession, it was found that with those gases which yielded a feeble sound, the displacement of a thermometric column associated with the bulb was slow and feeble, while with those gases which yielded loud sounds, the displacement was prompt and forcible.

Further Experiments.

Since the handing in of the foregoing note, on the 3rd of January, the experiments have been pushed forward; augmented acquaintance with the subject serving only to confirm my estimate of its interest and importance.

All the results described in my first note have been obtained in a very energetic form with a battery of sixty Grove's cells.

On the 4th of January I chose for my source of rays a powerful lime-light, which, when sufficient care is taken to prevent the pitting of the cylinder, works with admirable steadiness and without any noise. I also changed my mirror for one of shorter focus, which permitted a nearer approach to the source of rays. Tested by this arrrangement the stronger vapours rose remarkably in sounding power.

Improved manipulation was, I considered, sure to extract sounds from rays of much more moderate intensity than those of the lime-light. For this light, therefore, a common candle flame was substituted. Received and thrown back by the mirror, the radiant heat of the candle produced audible tones in all the stronger vapours.

Abandoning the mirror and bringing the candle close to the rotating disk, its direct rays produced audible sounds.

A red-hot coal, taken from the fire and held close to the rotating disk, produced forcible sounds in a flask at the other side.

A red-hot poker, placed in the position previously occupied by the coal, produced strong sounds. Maintaining the flask in position behind the rotating disk, amusing alternations of sound and silence accompanied the alternate introduction and removal of the poker.

The temperature of the iron was then lowered till its heat just ceased to be visible. The intermittent invisible rays produced audible sounds.

As might be expected from the foregoing experiments, an incandescent platinum spiral, with or without the mirror, produced musical sounds. When the battery power was reduced from ten cells to three, the sounds, though enfeebled, were still distinct.

My neglect of aqueous vapour had led me for a time astray in 1859, but before publishing my results I had discovered my error. On the present occasion this omnipresent substance had also to be reckoned with. Fourteen flasks of various sizes, with their bottoms covered with a little sulphuric acid, were closed with ordinary corks and permitted to remain in the laboratory from the 23rd of December to the 4th of January. Tested on the latter day with the intermittent beam, half of them emitted feeble sounds, but half were silent. The sounds were undoubtedly due not to dry air, but to traces of aqueous vapour.

An ordinary bottle, containing sulphuric acid for laboratory purposes, being connected with the ear and placed in the intermittent beam, emitted a faint, but distinct, musical sound. This bottle had been opened two or three times during the day, its dryness being thus vitiated by the mixture of a small quantity of common air. A second similar bottle, in which sulphuric acid had stood undisturbed for some days, was placed in the beam: the dry air above the liquid proved absolutely silent.

On the evening of January 7th Prof. Dewar handed me four flasks treated in the following manner:—Into one was poured a small quantity of strong sulphuric acid; into another a small quantity of Nordhausen sulphuric acid; in a third were placed some fragments of fused chloride of calcium; while the fourth contained a small quantity of phosphoric anhydride. They were closed with well-fitting india-rubber stoppers, and permitted to remain undisturbed throughout the night. Tested after twelve hours, each of them emitted a feeble sound, the flask last mentioned being the strongest. Tested again six hours later, the sound had disappeared from three of the flasks, that containing the phosphoric anhydride alone remaining musical.

Breathing into a flask partially filled with sulphuric acid instantly restores the sounding power, which continues for a considerable time. The wetting of the interior surface of the flask with the sulphuric acid always enfeebles, and sometimes destroys, the sound.

A bulb, less than a cubic inch in volume, and containing a little water, lowered to the temperature of melting ice, produces very distinct sounds. Warming the water in the flame of a spirit-lamp, the sound becomes greatly augmented in strength. At the boiling temperature the sound emitted by this small bulb* is of extraordinary intensity.

These results are in complete accord with those obtained by me nearly nineteen years ago, both in reference to air and to aqueous vapour. They are in utter disaccord with those obtained by other experimenters, who have ascribed a high absorption to air and none to aqueous vapour.

The action of aqueous vapour being thus revealed, the necessity of thoroughly drying the flasks, when testing other substances, becomes obvious. The following plan has been found effective:—Each flask is first heated in the flame of a spirit-lamp till every visible trace of internal moisture has disappeared, and it is afterwards raised to a temperature of about 400° C. While the flask is still hot a glass tube is introduced into it, and air freed from carbonic acid by caustic potash, and from aqueous vapour by sulphuric acid, is urged through the flask until it is cool. Connected with the ear-tube, and exposed immediately to the intermittent beam, the attention of the ear—if I may use the term—is converged upon the flask. When the experiment is carefully made, dry air proves as incompetent to produce sound as to absorb radiant heat.

In 1868 I had determined the absorptions of a great number of liquids whose vapours I did not examine. My experiments having amply proved the parallelism of liquid and vaporous absorption, I held undoubtedly twelve years ago that the vapour of cyanide of ethyl and of acetic acid would prove powerfully absorbent. This conclusion is now easily tested. A small quantity of either of these substances, placed in a bulb a cubic inch in volume, warmed, and exposed to the intermittent beam, emits a sound of extraordinary power.

I also tried to extract sounds from perfumes, which I had proved in 1861 to be absorbers of radiant heat. I limit myself here to the vapours of pachouli and cassia, the former exercising a measured absorption of 30, and the latter an absorption of 109. Placed in dried flasks, and slightly warmed, sounds were obtained from both these substances, but the sound of cassia was much louder than that of pachouli.

Many years ago I had proved tetrachloride of carbon to be highly diathermanous. Its sounding power is as feeble as its absorbent power.

In its relation to colliery explosions the deportment of marsh-gas was of special interest. Prof. Dewar was good enough to furnish me with a pure sample of this gas. The sounds produced by it, when exposed to the intermittent beam, were very powerful.

Chloride of methyl, a liquid which boils at the ordinary temperature of the air, was poured into a small flask, and permitted to displace the air within it. Exposed to the intermittent beam, its sound was similar in power to that of marsh-gas.

---

* In such bulbs even bisulphide of carbon vapour may be so nursed as to produce sounds of considerable strength.

The specific gravity of marsh-gas being about half that of air, it might be expected that the flask containing it, when left open and erect, would soon get rid of its contents. This, however, is not the case. After a considerable interval, the film of this gas clinging to the interior surface of the flask was able to produce sounds of great power.

A small quantity of liquid bromine being poured into a well-dried flask, the brown vapour rapidly diffused itself in the air above the liquid. Placed in the intermittent beam a somewhat forcible sound was produced. This might seem to militate against my former experiments, which assigned a very low absorptive power to bromine vapour. But my former experiments on this vapour were conducted with obscure heat, whereas in the present instance I had to deal with the radiation from incandescent lime, whose heat is in part luminous. Now the colour of the bromine vapour proves it to be an energetic absorber of the luminous rays; and to them, when suddenly converted into thermometric heat in the body of the vapour, I thought the sounds might be due.

Between the flask containing the bromine and the rotating disk, I therefore placed an empty glass cell: the sounds continued. I then filled the cell with transparent bisulphide of carbon: the sounds still continued. For the transparent bisulphide I then substituted the same liquid saturated with dissolved iodine. This solution cut off the light, while allowing the rays of heat free transmission: the sounds were immediately still.

Iodine vapourised by heat in a small flask, yielded a forcible sound, which was not sensibly affected by the interposition of transparent bisulphide of carbon. Like those of the bromine the sounds of the iodine vapour were completely quelled by the iodine solution. It might indeed have been foreseen that the rays transmitted by the iodine as a liquid would also be transmitted by its vapour, and thus fail to be converted into sound.*

To complete the argument:—While the flask containing the bromine vapour was sounding in the intermittent beam, a strong solution of alum was interposed between it and the rotating disk. There was no sensible abatement of the sounds with either bromine or iodine vapour.

In these experiments the rays from the lime-light were converged to a point a little beyond the rotating disk. In the next experiment they were rendered parallel by the mirror, and afterwards rendered convergent by a lens of ice. At the focus of the ice-lens the sounds were extracted from both bromine and iodine vapour. Sounds were also produced after the beam had been sent through the alum solution and the ice-lens conjointly.

With a very rude arrangement I have been able to hear the sounds of the more active vapours at a distance of 100 feet from the source of rays.

Several vapours other than those mentioned in this abstract have been examined, and sounds obtained from all of them. The vapours of all compound liquids will, I doubt not, be found sonorous in the intermittent beam. And, as I doubt whether there is an absolutely diathermanous substance in nature, I think it probable that even the vapours of elementary bodies, including the elementary gases, when more strictly examined, will be found capable of producing sounds.

---

* I intentionally use this phraseology.

Royal Institution of Great Britain.—At the General Monthly Meeting on Monday, February 7, 1881, William Bowman, LL.D., F.R.S., Vice-President, in the Chair, Miss Adalbertha F. Dubort, Robert Hamilton Few, F.R.G.S., Thomas Gabriel, Mrs. Caroline Gabriel, Mrs. Elizabeth F. Hight, John Henry Knight, Edward W. Lane, M.D., M.A., Walter Farquhar Larkins, Lieut-Col. Llewellyn Wood Longstaff, F.R.G.S., F.Z.S., and Arthur Vacher, were elected Members of the Royal Institution.

ON A

NEW APPARATUS FOR SHOWING THE DISSOCIATION OF SALTS OF AMMONIUM.

By Dr. D. TOMMASI.

This apparatus—which I shall call the "Dissocioscope"—is composed (as is shown in the accompanying drawing) of a glass tube 20 or 25 centimetres high and 3 or 4 centimetres in diameter. In the interior of the tube a strip of blue litmus-paper is suspended by a platinum wire, the paper having been previously moistened with a solution of chloride of ammonium.* As the solution of this salt is generally slightly acid, it should be neutralised with a few drops of ammonia; but care must be taken not to add too much, as that might be prejudicial to the reaction subsequently to take place. The solution of chloride of ammonium (pure) in distilled water should be made at the ordinary temperature, and should be a saturated solution. The strip of litmus-paper, after being taken out of the chloride of ammonium, is slightly dried between two pieces of blotting-paper, and whilst still moist is put in the glass tube.

To perform the experiment, all that is necessary is to plunge the tube into a cylinder of boiling water. The sal-ammoniac immediately dissociates, and the litmus-paper turns red. If the dissocioscope be then plunged into cold water the small quantity of dissociated ammonia recombines with the hydrochloric acid, and the litmus-paper regains its blue colour.

It is evident that this experiment can be repeated as often as desired, and the same results will always be obtained.†

Behaviour of Alcohols with Zinc Powder.—Dr. H. Jahn.—Alcohols distilled with zinc powder heated to between 300° to 350° are resolved into hydrogen and olefine. This decomposition especially takes place with the higher alcohols, beginning with the ethylic. Under the same circumstances methylic alcohol is decomposed into hydrogen and carbonic oxide, and yields a small quantity of marsh-gas.—*Les Mondes.*

---

* By substituting for the chloride of ammonium the bromide, sulphate, or nitrate, &c., the same apparatus will show the dissociation of these different salts of ammonium.

† The "Dissocioscope" can be procured from Alvergniat, 10, Rue de la Sorbonne, Paris.

ON THE
CHEMISTRY OF SEWAGE PRECIPITATION.*
By Dr. WILLIAM WALLACE.

(Continued from p. 34).

In Birmingham lime has always been the precipitant employed, and a great improvement has been effected in the condition of the river Tame, yet the results are not so satisfactory as they might be if a somewhat different system of working were adopted. The sewage, after receiving its dose of lime, passes through a series of settling tanks; but as the lime precipitate is so light that it will not settle completely unless the water is absolutely at rest, it follows that the effluent is always more or less turbid. I consider it imperative that, where lime is used as the purifying agent, the effluent be further subjected to filtration, either through land, where it can be had of a suitable nature, or through "breeze" or some other suitable material. This fact is now recognised by the Birmingham authorities, who expect in future, by a system of land filtration, to produce a more perfect effluent than they do at the present time. There is a farm of considerable dimensions in connection with the sewage works, the principal use of it being for the disposal of the sludge, the quantity of which is enormous. It is got rid of by covering the ground with a layer of it, and then digging it in. Excellent crops of certain vegetables are produced. Formerly works were in operation to carry out the processes of General Scott for the manufacture of cement from the sludge, and for the treatment of night-soil, but both of these have been abandoned.

In Leeds, where the "A B C" and several other processes have been tried, lime alone is now used, and the results are considered satisfactory so far as the effluent is concerned, although it is not subjected to any description of filtration. Its condition, however, is of the less consequence, since, under any circumstances, it is likely to be purer than the water of the Aire, into which very dirty river it is admitted. Here, as elsewhere, the sludge is the chief difficulty: it is indeed the *bête noir* of sewage purification everywhere, and no town or city should adopt a system of precipitation until it is clearly seen how the sludge is to be disposed of. No matter how it is made or what it contains, it cannot be sold; nor will farmers take it for the lifting in its wet state, except in insignificant quantities. An attempt was made at Leeds, two years ago, to convey away the sludge in barges; but the way in which it was carried out clearly showed that those in charge had no correct conception of the difficulties connected with the process. No sludge is now dried at Leeds, for the obvious reason that the drying costs more than can be obtained for the finished article. On the other hand, the cost of working the precipitation is now much less than it was formerly. Four or five years ago the materials for a modified "A B C" process cost at the rate of 18s. 3d. per hour, while now a quantity of lime (7 tons), costing about £5, suffices for the whole 24 hours. The effluent is satisfactory unless when the sewage is mixed largely with tanners' refuse, when it is of a distinctly brown tint, which lime will not remove. The quantity of sewage averages about 9 million gallons per day, but is sometimes much more.

In Bradford, where lime alone has been used for several years, the average flow of the sewage is 8 million gallons per day. The works are capable of dealing with 10 million gallons; but if by reason of heavy rainfall, this quantity is exceeded, the surplus is passed direct into the Beck, a stream of extraordinary filthiness, which is not likely to be further contaminated by it. The system of precipitation pursued in Bradford differs from any I have seen elsewhere, in this respect, that the sewage does not run continuously into and out of the tanks, but these, which are of comparatively small dimensions, are filled and emptied every hour or so, and the sewage is allowed about three-quarters of an hour of absolute quiescence, during which the precipitate settles down completely. The effluent is passed through or over breeze (riddlings of gas coke), whereby its composition is greatly improved, and it passes into the Beck quite clear, and only faintly coloured by dye-stuffs. I have made analyses of the effluent as first produced, and after passing through the filtering material, and the results show that not only is all supended matter removed, but also that the free lime (so injurious to fish when introduced into a river), is almost all carbonated, and for the most part removed. If we compare with this the composition of the Bradford Beck, taken above the sewage works, it will be seen that it must be considerably improved by the admixture of the purified sewage. Experiments on the large scale at Bradford have shown that, in order to obtain satisfactory results, it is necessary to employ a lime of the best quality. The sludge has hitherto been used exclusively in the making up of waste land in the vicinity of the works, but experiments are now being made with the object of reducing it to a more portable form, so that it migh realise the cost of carriage to some distance. Although the treatment of the sludge afte it is deposited in the precipitating tanks is not all that can be desired, the Bradford works are, on the whole, the best I have seen, and are well worth the study of any Corporation who purpose to adopt precipitation as the means of purifying sewage.

In Bolton, lime is used in conjunction with a certain proportion of carbonaceous matter, and the results are stated to be satisfactory. Owing to the flooded condition of the river, the works were at a stand-still when I visited the town on two occasions. I have, however, ascertained the composition of the dried sludge and the effluent water.

In Windsor the process of Mr. Fritz Hillé is followed. It is a modification of the lime process, "chemical salts" (chiefly chloride of magnesium), and a small quantity of tar being added along with the lime. The "salts" are stated to hasten the deposition of the sludge, while the tar retards the decomposition of the effluent. In the ground connected with the works, which are situated at "The Ham," about three miles from the town, trenches are dug, into which the sludge is run, and as the soil is gravelly the liquid portion readily passes away, leaving the mud in a state in which it can be handled. The composition of the sludge is not essentially different from that obtained with lime alone, and, indeed, contains much less magnesia than that produced at Leeds and Bradford, where, probably, magnesium salts are largely employed in finishing and weighting woollen goods and mixed fabrics. The effluent is further purified by irrigation or land filtration. The ordinary quantity of sewage is 1½ million gallons per day. The tanks and other apparatus are very well arranged. Tottenham and some other places are also worked on Hillé's system.

Coventry has been working for some years under Dr. Anderson's patent, in which sulphate of alumina, with enough lime to throw down the alumina, is employed. At present the works are in the hands of the Rivers Purification Company, to whom the city pays £2,200 per annum for the treatment of the sewage, which amounts to 2 millions gallons per day. The condition of matters here is very much the same now as they were when I visited the works some years since, except in this respect, that all hope of selling the sludge, except for the merest trifle of remuneration, appears to be now at an end; the drying is abandoned, and the sludge is got rid of by spreading on fields, &c. The use of sulphate of alumina is interesting, as it is really the only competitor with lime. The quality of the salt used at Coventry is of the crudest and poorest description; and as the effluent is very good, it shows that a material of the cheapest kind may be successfully employed. No doubt the process, under any circumstances, must involve a greater outlay than if lime were employed, but I consider that this is counterbalanced, to a very considerable extent, by the diminished quantity of sludge to be disposed of. If the phosphoric acid be accepted as the measure of

---

* A Paper read before the Chemical Section of the Philosophical Society of Glasgow, December 6, 1880.

the manurial strength of the sludge, it will be seen, on comparing the various analyses, that the article produced in works where sulphate of alumina is the precipitant is from twice to three times as strong as that precipitated by lime: in other words, the quantity of sludge is from twice to three times as great in the latter case as in the former, while the effluent from sulphate of alumina is at least as good as that from lime, and does not require, so imperatively, subsequent filtration through gravelly soil or breeze. Then, again, if there is any hope of disposing of the dried or partially dried sludge by sale to farmers, there is a far greater probability of doing so if the calculated value per ton is from 20s. to 27s., as at Coventry, than if it were only from 11s. to 15s., as it is in various places where lime alone is used as the precipitant. In Coventry there is used, along with the sulphate of alumina, a small quantity of copperas (sulphate of iron), and enough milk of lime is afterwards added to make the liquid faintly alkaline. The exact quantities are, for 1,000,000 gallons, 15 cwts. sulphate of alumina, 2½ cwts. copperas, and 6½ cwts. lime. The sewage then passes on to the precipitating tanks, of which there are four, each capable of containg 225,000 gallons, and they are wrought on the continuous system, three being always in use, while the fourth is being cleared out. The precipitate goes down rapidly, much more so than when lime alone is used, and the effluent passes off in a constant stream in a fairly purified condition, but usually of a faint rose-colour, arising from the dye-stuffs present in large quantities in the sewage. It is afterwards passed through 9 acres of land laid off as a filtering ground, and separated into portions which are wrought intermittingly. These plots are cropped with mangold, rye-grass, &c., and a portion is planted with osiers, which grow vigorously and yield a good return. The effluent passes into the River Sherbourne at the lowest part of the ground, thoroughly purified from suspended matter and quite inodorous, but still of a faint rose tint.

In Aylesbury the process of the A B C Company has been adopted. The sewage looks very foul, and although on both occasions when I visited the town the works could not deal with the whole of it, that portion which was treated produced an excellent effluent. The substances used for purification are sulphate of alumina and charcoal with or without the addition of clay. No lime is used, as the sewage contains enough free ammonia to decompose the sulphate of ammonia. The sludge is pumped up to a tank on the roof of the buildings, and brought down by a pipe into a filter-press, in which the water is reduced from 90 or 95 per cent to 50 per cent. It is now in the form of cakes, which, when kept in a store or in the open air during dry weather, become dry to the touch, and when ground form "native guano," which is sold for £3 10s. per ton, the calculated value being, however, only 33s., while the selling price, comparing it with farm-yard manure, should be less even than this. The cost of production is given by Mr. Henry Robinson, C.E., in his paper on "Sewage Disposal," 1879, as follows:—Chemicals, labour, &c., £1 12s.; drying, &c., 5s. 8d.; grinding and bagging, 15s. —in all £2 12s. 8d. per ton. This process suits very well for a small population, such as that of Aylesbury (about 6000), situated in the middle of a rich agricultural district, where a small quantity of artificial manure may be disposed of by active agents or by extensive advertising; but it does not appear to be applicable to a large town, where it would be impossible to dispose of more than a trifling quantity of the sludge, and there would be, therefore, nothing to counterbalance the heavy outlay for chemicals. Besides this, it would be impossible to obtain, in sufficient quantity for a large town, the carbonaceous matter, which is an essential ingredient in the process. This is a by-product in the manufacture of prussiate of potash, and the production of it is limited. I do not know any other kind of charcoal, suitable for the purpose, that could be had except at a cost that would preclude its use for sewage purification.

The separation of the sewage proper, and especially that from water-closets, from the surface drainage, has been brought prominently before the citizens of Glasgow, and I consider it necessary to make a few remarks on the subject. It is supposed by some that if the products of the water-closets were kept distinct, amounting, say, to a million gallons a-day, all the other drainage of the city might be passed into the river without danger of causing a nuisance. But I have shown conclusively, by chemical analyses, that the drainage from districts where there are no water-closets is very nearly as foul as that from those provided with those conveniences. The latter use a much larger quantity of water, and this dilution compensates, or nearly so, for the extra amount of impurity. A little consideration will show that, practically, all the water used for domestic purposes is, and must be, more or less foul, and requires purification before being introduced into a river. For example, no liquid enters more readily into putrefaction than the water in which cabbage and other vegetables have been boiled; and the washing of cooking utensils gives rise to very foul water. In fact, kitchen slops of all kinds are very impure, and the soapy water resulting from the washing of clothes is, in many many cases, nearly as bad. In the houses of the industrial classes the kitchen sinks are freely used for purposes for which they were never intended; and, in fact, with the exception of the solid excrement, the sewage contains practically all that is found in that produced in water-closet districts. It comes to this, then, that under the separate system, properly carried out, all that is saved from going into the sewers is the rainfall. In Leicester, where two distinct sets of drains exist, the quantity of sewage from a population of 120.000 is 7 million gallons a day; and the somewhat unsatisfactory condition of the Soar in hot weather is considered to be due, at least in part, to the fact that the street washings pass into the river without purification.

As regards the system of precipitation which it is desirable to adopt in the case of Glasgow, I do not consider it imperative that this point be settled before proceeding with the works. For both systems—that using lime and that in which sulphate of alumina, with or without lime, is employed—the same tanks, apparatus, and filtering beds are required, the only difference being that when the latter process is used, the filtering beds do not require to be quite so extensive as when lime is the precipitant. Glasgow is well situated for both processes: lime of the finest quality can be had at from 12s. to 14s. per ton, and probably, from the dilute nature of the sewage, 15 cwts. per million gallons would suffice; on the other hand, a crude sulphate of alumina, containing also some sulphate of iron, could be made here from the waste shale of our coal fields at a very low price, and the use of this precipitant would keep down the quantity of sludge. The disposal of this substance is one of the most important considerations in the establishment of sewage precipitation works. There is a vast quantity of waste land on both sides of the river which might be reclaimed and rendered valuable by means of the sludge, and I see no reason why it should not be sent off considerable distances by railway, as is done at present with the town refuse, to enhance the value of arrable land. But having several precipitation works, facilities would be given for conveying the sludge in various directions.

Whatever system of precipitation be adopted, the disposal of the sludge is one of the most important elements in the calculation of cost. I have estimated that the sewage of Glasgow—40 to 70 millions of gallons daily—will produce a quantity of sludge which, in the dried state, would amount daily to 135 tons; but as it must be dealt with in its moist condition, it would be a fair estimate to take five times this, or 675 tons, as the quantity to be daily got rid of. If lime alone were used as the precipitant, an average of about 40 tons would be required daily, which, at 12s. per ton, would cost £24 a day, or £8760 per annum. The total cost of working the precipitation process, not including interest on works, would probably amount to somewhere about £25,000 per annum.

(To be continued.)

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, February 3rd, 1881.

Dr. J. H. Gladstone, F.R.S., Vice-President, in the Chair.

The following certificates were read for the first time:—W. E. Adeney, R. A. Edgell, M. Hiddingh, O. V. Pisani, L. T. O'Shea. It was announced that a ballot for the election of Fellows would take place at the next meeting of the Society (February 17). The following papers were read:—

"*On the Estimation of Organic Carbon in Air*," by Drs. Dupré and Hake. In a previous paper (*Journ. Chem. Soc.*, March, 1879) the authors demonstrated the possibility of estimating gravimetrically minute quantities of carbon by burning in a current of oxygen, absorbing the carbonic acid in baryta water, converting the carbonate into sulphate, and finally weighing the barium sulphate thus obtained; the substance thus formed weighing 19·4 times as much as the original carbon. The air to be analysed was conducted by glass tubing into the laboratory, and there, after filtration through asbestos, divided by a T-piece and suitable pinchcocks into two equal currents. One of these was sucked through an absorbing apparatus containing baryta water, the other passed first through a porcelain tube containing copper oxide heated to redness and then through an absorption-tube. The result obtained with the first current obviously gives the CO_2 in the air; that with the second, the CO_2 in the air plus the CO_2 due to the combustion of any organic carbon. 10 litres of the ordinary air round the laboratory, after filtration through asbestos, gave 0·0001 to 0·0002 grm. of carbon present as organic carbon. The quantity of air employed in each experiment varied from 4½ to 16 litres. Details of the various experiments are given. The authors have not yet attempted to estimate the suspended organic carbon. The authors criticise the results previously obtained by Boussingault, who found in 10 litres 0·0019 grm. carbon; and by Verser, who obtained in 10 litres 0·00154, about ten times as much as the mean result obtained by the authors (0·000154). They also refer to the results obtained by Pettenkofer in his well-known experiments on the elimination of H and CH_4 by animals. Pettenkofer seems to have assumed that the air in his experiments was free from organic carbon, and thus to have laid his results, on that subject, open to a serious fallacy.

The Chairman remarked on the importance of having a method for estimating satisfactorily the organic carbon in the atmosphere, especially in towns subject to visitations of fog, &c.

In answer to some questions, Dr. Dupré stated that the greatest precautions were taken in making the joints; the glass tubes always overlapped, so as to expose the air as little as possible to the caoutchouc tubing. Ordinary metal gas-tubing was at first employed, but absorbed so much CO_2 that its use had to be abandoned. The excess of carbon found by Boussingault might perhaps be explained by the copper employed by him containing carbon.

Mr. Williams pointed out that ordinary black rubber tube was very pervious to CO_2.

The next paper was "*On the Action of the Copper-Zinc Couple upon Nitrates, and the Estimation of Nitric Acid in Water Analysis*," by M. W. Williams. The estimation is conducted as follows:—Some strips of zinc-foil are placed in a wide-mouth-stoppered bottle, and covered with a 3 per cent copper sulphate solution. When the zinc has acquired a sufficient coating of copper, the solution is poured off, and the copper-zinc couple washed with distilled water, and finally with the water to be analysed. The couple is again drained, and the bottle then filled with the water, stoppered, and placed in a warm (24° C.) situation until the reduction of the nitrates is completed. The clear fluid is then withdrawn and titrated directly by the Nessler method; about 1 sq. decimetre of zinc should be used for every 200 c.c. of water containing 5 parts of NH_3 in 100,000. By saturating the water previously with CO_2, or by adding a little pure sodium chloride to the water, the reaction can be expedited so that it is completed in a few hours. The nitrates are apparently first converted into nitrites and the nitrites into ammonia. As soon as the water contains no nitrites the conversion of the nitrates into ammonia is complete. In order to ascertain when this is the case the author employs meta-phenylene-diamine, which in acid solution gives an intense yellow colour with nitrous acid. To calcareous waters which give a turbidity when the Nessler reagent is added, the author adds a fragment of pure oxalic acid, allows the oxalate to settle, and titrates the clear liquid. The author has investigated the effects of temperature and the addition of various substances on the rapidity of the above reaction. At low temperatures the formation of ammonia is much retarded. The presence of alkalies, sodium hydrate, calcium hydrate, &c., retard, whilst carbonic acid, sodium chloride, &c., accelerate the reaction. The author also gives tables showing the amounts of nitrous acid and ammonia formed at different intervals after the commencement of the experiments. In conclusion the author stated that he had applied the reaction so as to shorten the well-known process of Frankland and Armstrong considerably, and had been able to avoid the addition of sulphurous acid in the process. He hoped to publish these results shortly.

In answer to a question of Mr. Groves, the author stated that bicarbonate of soda hindered the reaction quite as much as the carbonate.

Mr. Maxwell Lyte suggested that as the action of the copper-zinc couple seemed to be electrolytic, the retardation produced by sodium carbonate and the acceleration by sodium chloride were simply due to alterations in the electrical conductivity of the solution.

Prof. Tidy did not quite understand the special advantage of this process over the indigo method. Following out some suggestions given him by Dr. Voelcker, he was now able to estimate the nitrates present in a water with perfect accuracy in ten minutes. In his hands the aluminium method had failed.

Dr. Dupré thought that the great value of Mr. Williams's process was in connection with Frankland and Armstrong's combustion method. If the use of sulphurous acid could be avoided, and the nitrates got rid of by the copper-zinc couple, this method of water analysis would be almost perfect.

Mr. Warington made some remarks as to the precautions which should be taken, in employing the meta-phenylene-diamine test for nitrites. Solutions of different strengths could not be compared together: he had found the method given in Frankland's treatise on "Water Analysis" work well. He did not quite see the advantage of the author's method of estimating nitrates over the indigo method.

Mr. W. Thorp thought that the author's method would be of more importance in connection with the estimation of organic carbon and nitrogen in water than as a method for estimating nitrates. He did not feel inclined to join in Prof. Tidy's condemnation of the aluminium method; he had had much experience with it at one time, and found that it worked satisfactorily. He had some difficulties with it with two classes of waters—rain-water and sea-water. He agreed with Mr. Warington that a direct estimation of the ammonia in water (without distilling) was never satisfactory.

Mr. Lloyd had used the indigo process and the copper-zinc process side by side; in his opinion the first, as modified by Dr. Voelcker, was the most expeditious.

Mr. Williams, in reply, said that he did not distil the water before Nesslerising. To calcareous waters he added a crystal of pure oxalic acid, which precipitated the lime;

he had not found it necessary to distil the water. He thought that when his process was combined with Frankland and Armstrong's chemists would prefer it to the aluminium method. He asked Mr. Thorp how he ascertained when the action of the aluminium had ceased.

Mr. Thorp replied that as all action ceased in five to six hours, and no more ammonia was formed in forty-eight hours than in six, he concluded that all the nitrates were decomposed. He thought that, although the lime might be precipitated, the natural colour of a water would often interfere with the Nesslerising unless the water was distilled.

"*On the Position taken by the Nitro-group on Nitrating the Dibromo-toluenes*," by R. Nevill and A. Winther. The authors conclude that bromine, as well as CH_3, has a tendency to cause the nitro-group to take up a position para to it; or if the para position be occupied, then an ortho position; and further, that the combined influence of CH_3 and one bromine atom can cause the nitro-group to take a position meta to the second bromine atom.

"*On some of the Various Derivatives of Toluene and the Toluidines*," by R. Nevill and A. Winther. The authors have prepared and studied brom-nitro-toluene obtained by the action of ethyl-nitrite on brom-nitro-toluidine, melting-point 74° to 75°. By the action of tin and hydrochloric acid on the first-mentioned substance an oily ortho-brom-para-toluidine was formed, which after solidification melted at 25° to 26°. By the addition of bromine water to a hydrochloric acid solution of this substance, tribromo-para-toluidine was obtained, melting-point 82·5° to 83°. By converting dibromo-nitro-toluidine, melting-point 125° to 130°, into diazo-perbromide, and decomposition with glacial acetic acid, tribromo-nitro-toluene, melting-point 105·8° to 106·8°, was obtained. By reduction with iron and acetic acid tribromo-toluidine, melting-point 118° to 118·6°, was procured. A tetra-bromo-para-toluidine was obtained by the action of bromine water on dibromo-para-toluidine in HCl solution. In conclusion the authors give a table containing the various bromine, nitro, and bromo-nitro-derivatives of toluene and the toluidines investigated by themselves and other chemists.

The Society then adjourned to February 17th, when a ballot for the election of Fellows will take place, and the following papers will be read:—"On a New Apparatus for showing the Dissociation of Ammonium Salts," hy D. Tommasi; "On the Estimation of Organic Carbon and Nitrogen in Water Analysis, simultaneously with the Estimation of Nitric Acid," by M. W. Williams.

Erratum.—In last report, page 42, line 37 from top, *after* "molecule" *insert* "of tetrathionate with a molecule."

CORRESPONDENCE.

BENZOL BOILING-POINTS.

To the Editor of the Chemical News.

Sir,—A "Country Tar Distiller" (Chemical News, vol. xliii., p. 46) asks if it is true that the "very unpleasant discrepancies constantly occurring between parties engaged in the sale and purchase of commercial benzol" are due to the fact that the thermometers used in the testing of these benzols differ in the lengths of their indicating columns. I do not think that this is a cause of many discrepancies, there being but little difference in the lengths of the indicating columns of the thermometers used for testing benzols in various parts of the country. Since the minimum and maximum temperatures required in the testing of commercial benzols are 80° C. and 120° C., the length of the indicating column between these two points is the only portion of the thermometer to be considered. That the length of the indicating column can affect the result of the test but little will be well understood if we suppose that we have to deal with a sample, say, of 50 per cent benzol, *i.e.*, a sample which should yield 50 per cent of its bulk on distillation to a temperature of 100° C. 100 c.c. of the benzol are placed in a retort connected with a condenser, the thermometer being fixed in the retort by means of a perforated cork. Heat is applied to the retort; in five or ten minutes ebullition commences at a temperature of about 90° C., and the temperature rises slowly as the distillation proceeds till the thermometer registers 100° C., when the heat is withdrawn, and distillation ceases, the time required being from fifteen to twenty minutes. Hence it will be seen that from one to two minutes is required for every increase of one degree C.; and since the difference between the length of the divisions of any two thermometers representing one degree C. is not likely to be more than $\frac{1}{32}$ of an inch, the thermometer which was influenced by this slight difference during a period of, say, one minute would have a slow action indeed. Thermometers should be so constructed that the length of the indicating column should make no appreciable difference in the quickness of the action. If the ratio between the capacity of the bulb and the bore and length of the tube be the same, then two thermometers differing in the length of their scale would indicate a certain number of degrees in the same time.

The cause of many of the discrepancies in benzol testing is that the test is so simple that its simplicity prevents many persons from seeing the importance of ensuring that the conditions under which the distillation is carried on shall be the same in each case. I suggest the following modification of the existing test:—100 c c. of the sample, which shall fairly represent the bulk, to be taken and placed in an *ordinary* 6-oz. stoppered retort connected with a Liebig's condenser, the condenser tube of which shall be 1 inch internal diameter and 2 ft. 6 in. long, the thermometer to be so fixed in the retort that its point shall be three-eighths of an inch from the lowest portion of the retort. Heat is applied by means of a Bunsen *rose* burner. When ebullition has commenced the heat is so regulated that the benzol shall distil over in separate drops from the end of the condenser tube into the 100 c.c. burette. When the required temperature is reached the heat is withdrawn, and the number of c.c. in the distillate is read off when the benzol has ceased to drop from the condenser tube. The contents of the retort, after cooling, are added to the distillate in the 100 c.c. burette, and the loss, if any, is added to the percentage of the distillate.

It is important that the retort and condenser used in every test should be similar, in consequence of the important part which surface condensation and adhesion play in this test. The heat should be withdrawn from the retort just before the required temperature is reached, as the temperature generally rises a little after the heat is withdrawn. No new cork should be used in important tests, as the absorption of benzol by the cork would lower the result of the test: and no new clean retort should be used, since it is difficult to obtain fair ebullition in a new retort unless a few grains of brick be introduced. Retorts which have been in use some time, and have a slight coating of carbon in the interior, are best adapted for important tests.—I am, &c.,

William W. Staveley.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, l'Académie des Sciences. No. 2, January 10, 1881.

Conditions Relative to the Theoretic Expression of the Speed of Light.—A. Cornu.—The theoretic expression of the speed of light proposed by M. Gouy does not rest upon any basis; the cause of the errors which he has committed is fundamentally what the author has pointed out on a former occasion, *i.e.*, the rejection of the consideration of persistent undulations, and finally the omission of the essential characters of a pencil of light.

Crystalline Substances Produced at the Expense of Antique Medals Immersed in the Hot Springs of Baiacci, in Corsica.—M. Daubrée.—Some of the medals were superficially coated with sulphur, and others with a double sulphide of copper and tin, the nearest natural analogue of which is stannine.

The Phylloxera in California.—F. de Savignon.—This pest has long been known by the Californian vine-growers. The comparative slowness of its inroads is ascribed to the non-existence of the insect in its winged state, to the richness of the soil, and to the existence of a parasitic enemy,—an Acarus, the *Tyroglyphus longior.*

Magnitude and Variations of the Images of Purkinje.—M. Croullebois.—A mathematical paper, not capable of useful abstraction.

A Thermo-regulator for High Temperatures.—M. d'Arsonval.—This apparatus cannot be intelligibly described without the accompanying illustrations.

The Detection of Gaseous Compounds, and the Study of some of their Properties by Means of the Spectroscope.—P. Hautefeuille and J. Chappuis.—The gases which issue from the effluve-apparatus of M. Berthelot may be usefully studied by means of the spectroscope. The absorption-bands of pure dry ozone, prepared with oxygen free from nitrogen, disappear slowly at common temperatures, but rapidly at redness, whether observed in close vessels, or as gaseous current. The spectrum finally becomes continuous. The same phenomenon is observed if we destroy by means of heat a mixture of ozone and nitrogen, if the latter has not traversed the effluve apparatus. The spectroscope enables us therefore to follow the isomeric transformation of ozone into oxygen, and to assert that its decomposition does not yield hyponitric acid, the only compound of nitrogen stable at dark redness. It is admitted that by avoiding the use of strong electric tensions the effluve-apparatus enables us to prepare ozone in presence of nitrogen without fearing the formation of hyponitric acid. The spectroscope shows that the electrisation of a very dry mixture containing at least one-seventh nitrogen occasions always at the ordinary temperature the formation of a body not yet described, characterised by a very remarkable absorption-spectrum. The spectrum observed on interposing a column of 2 metres filled with the gaseous mixture obtained under these circumstances, possesses all the large absorption-bands described by one of the authors as characteristic of ozone, and besides fine very black rays in the red, orange, and green. Nitrogen, nitrous, hyponitric, and nitric anhydrides when electrised do not present this spectrum. If the gases which give these two spectra are caused to bubble through water, this water becomes acid, and the gas no longer presents the spectrum of ozone. The introduction into the effluve apparatus of a gaseous mixture imperfectly dried quickly occasions the disappearance of the spectrum superimposed on that of ozone. The spectrum destroyed belongs, therefore, to an anhydrous compound, capable of producing an acid. The same gaseous mixture is rapidly decomposed at a red-heat, yielding hyponitric acid. The spectroscope permits us to follow the phenomenon; the bands of ozone and the new bands are gradually replaced by the bands characteristic of hyponitric acid which remain alone. The decomposition is slow at the common temperature, and if followed with the spectroscope it presents a very important peculiarity. During the period of twenty-four to forty-eight hours the bands of the new body have totally disappeared without a trace of hyponitric acid, which then appears gradually, and the decomposition is complete at the end of some days. From these facts it may be inferred that the body formed is first decomposed into oxygen and nitric anhydride, which in turn is resolved into hyponitric acid and oxygen. The body capable of giving the new spectrum is therefore susceptible of yielding hyponitric acid on decomposition. In connection with these results M. Berthelot remarks that hyponitric acid if submitted to the action of the effluve in presence of oxygen becomes colourless. The authors, repeating this experiment, find that the mixture in question not merely becomes colourless, but presents the bands of the new compounds without those of hyponitric acid. These experiments are easily interpreted if we admit the existence of pernitric acid.

The Bromides and Iodides of Phosphorus.—M. J. Ogier.—A thermo-chemical study.

Bulletin de la Société Chimique de Paris.
No. 1, July 20, 1880.

Action of Certain Chlorides on Aniline Colours.—Girard and J. A. Pabst.—The authors introduced into tubes the chlorides of silicon, $SiCl_4$, of carbon, CCl_4, and of tin, $SnCl_4$, with four times their respective volumes of chemically pure aniline, which with arsenic acid yielded not more than 1-5000th of its weight of mauvaniline without a trace of red or yellow. The tubes were sealed and heated for twelve hours to 225° to 230°. No pressure was observed when they were opened. The carbon perchloride had produced triphenyl-guanidine, rosaniline, and a brown matter, offering all the reactions of Bismarck brown, which is well known to be produced by the action of aniline hydrochlorate upon rosaniline. Tin perchloride yielded violaniline and mauvaniline in small quantity, a large proportion of rosaniline or para-rosaniline; also Bismarck brown, and a trace of a green matter. Silicon chloride yielded violaniline, and especially triphenylene diamine blue, as well as a trace of mauvaniline. Antimony perchloride, heated with aniline to 125°, reacted very violently, forming violaniline, a small quantity of triphenylene diamine blue, and a certain quantity of a blue matter, analogous to that produced by the action of hydrochloric acid upon the azoic compounds. Thus, notwithstanding the parallelism of their properties and constitutions, carbon chloride yields rosaniline; silicon chloride, violaniline; and tin chloride, both these colouring-matters.

Russian Chemical Society.—Session, September 6/18, 1879.—M. Latchinoff described a remarkable oxidation-product of cholalic acid.

MM. Beilstein and Jawein gave a new method for the direct separation of manganese and iron, based upon the fact that all the salts of manganese are precipitated as peroxide when boiled with concentrated acid and potassium chlorate.

M. Sorokine finds that the oxidation of diallyl with an aqueous solution of chromic acid yields, not merely a mixture of carbonic and acetic acids, but also a small quantity of fixed acids, including the succinic.

M. J. Ossipoff gives a preliminary notice on the ethers of fumaric and maleic acids. He also announces that fumaric acid is not oxidised by nitric acid of sp. gr. 1·2 to 1·4.

M. Menchoutkine spoke on the influence of the isomerism of the saturated mono-basic acids upon the formation of compound ethers.

M. Mendelejeff described the sulphur deposits of Sicily and the mode of their formation.

M. Wischnegradsky gave a preliminary communication on a new base derived from quinine.

The seventh part of vol. xi. of the *Journal of the Russian Chemical Society* contains further a long memoir by M. Lubavine on the nucleine of milk. He concludes that nucleine is a mixture of at least two substances, which differ respectively in their proportion of phosphorus.

Moniteur Scientifique, Quesneville.
August, 1880.

Industrial Society of Mulhouse.—At a special meeting of the Society, June 14, a letter was read from M. Caro contending that Messrs. Lloyd and Dale, and not Mr. Thomas Brooks, invented the process for fixing aniline colours by the joint action of tannin and tartar-emetic. A silver metal was offered for a decided yellow colour equal in permanence to alizarin, and fixed in the same manner. A note from M. Brandt was read on the preparation of stannic sulphocyanide by the double decomposition of calcium sulphocyanide and stannic oxalate. It is likely to find extensive applications in calico printing. M. Dollfus read some extracts from a report on cadmium yellow. M. Jacquet has observed that a few grms. of a salt of cadmium added to a chromate of lead colour, considerably retard the sulphuration of the latter during steaming. MM. Noelting and De Salis communicated investigations on the nitrised cresylols. On treating the diazoic derivative of ortho-toluidine with nitric acid they obtained a binitro-cresylol fusible at 86°, and yielding crystalline yellow salts. It appears to be identical with a compound discovered by M. Piccard in a commercial product known as saffron substitute.

New Synthesis of Desoxy-benzoin and Crysen. MM. Graebe and Bungener.—The authors have obtained desoxy-benzoin by causing the chloride of phenyl-acetic acid to react upon benzol in presence of aluminium chloride. By the same reaction, naphthalin being substituted for benzol, they produce benzyl-naphthyl-keton. They then reduce with hydriodic acid and phosphorus at 150° to 160°, and pass the vapours of the carbide thus obtained through a red-hot tube, when 4 atoms H are removed and chrysene remains.

Chlorinated Derivatives of Carbazol.—W. Knecht.—On treating carbazol suspended in acetic acid with chlorine, the liquid turns blue, yellowish, greenish, and, lastly, red. If the reaction is then interrupted the product is trichloro-carbazol in white needles, melting at 185°. If the process is continued for ten to twelve hours, hexachloro-carbazol is produced, fusible at 225°.

A Novel Ferric Hydrate.—C. Graebe.—The author has received from the Baden Aniline and Soda Works a reddish crystalline substance deposited in cast-iron vessels in which potash had been melted. It has the same composition as hematite and gœthite, but its specific gravity is only 2·93.

Manufacture of Soda from Sulphate.—J. Putzkow.—Salt-cake is produced in quantity in California in the manufacture of nitric acid. As coal and lime-stone are dear in California, Le Blanc's process is not economical. The author therefore proposes to mix a solution of salt-cake with calcium sulphite and pass in sulphurous acid. Soluble calcium bisulphite is formed, and by decomposition calcium sulphate and sodium bisulphite. The two salts are separated by filtration, and the sodium bisulphite is treated with milk of lime. The result is a solution of caustic soda, retaining a certain quantity of sodium sulphite and sulphate, which is evaporated down in the usual manner, and calcium sulphite, which is used again in the process.—*Dingler's Pol. Journ.*

Observations on the "Mother" of Vinegar.—J. B. Schnœtzler.—The so-called "mother of vinegar" is an accumulation of the fungus *Mycoderma aceti*, which Pasteur has ascertained to be the agent in the transformation of wine into vinegar. The so-called *fleur de vin* (*Saccharomyces mycoderma*) is a perfectly distinct organism and does not induce acetification, but the alcoholic fermentation.

The Banishment of Bees.—At the petition of the Parisian refiners of beet-root sugar, the Prefect of the Seine has proscribed bees in the neighbourhood of the city. A single refiner in the 13th arrondissement estimates his losses at 25,000 francs.

Perforation of Zinc Reservoirs.—X Rocques.—The causes which lead to calcareous deposits and the corrosion of leaden pipes occasion likewise the attack of zinc reservoirs, *i.e.*, the chemical action of the salts dissolved in the water, and the electric action of lead and copper or lead and iron.

September, 1880.

Preparation of the Salts of Uranium and Vanadium at Joachimsthal, Bohemia. — C. Lallemand. — The uranium ore is pitch-blende of the sp. gr. 7. It contains on an average 40 to 55 per cent of urano-uranic oxide (U_3O_4), besides vanadium, arsenic, sulphur, molybdenum, tungsten, cobalt, nickel, copper, bismuth, lead, silver, iron, manganese, lime, magnesia, alumina, and silica. The analysis of the sample is thus performed; a portion of 3 grms. is heated on the sand-bath with moderately concentrated nitric acid. At the end of two hours the reaction is complete; the solution is decanted, and the residue filtered and washed with hot water till the washings no longer give the characteristic red colour with potassium ferrocyanide. The collected liquid is then mixed with sodium carbonate in excess, and boiled to expel free carbonic acid. The totality of the vanadium, iron, lime, lead, copper, &c., is thus precipitated, whilst uranium remains in solution. The sediment is allowed to settle for some hours, after which it is decanted, washed with hot water by decantation, filtered, and washed upon the filter with hot water until the washings, after slight acidulation with hydrochloric acid, no longer give a red colouration with potassium ferrocyanide. The excess of sodium carbonate is then decomposed by the addition of hydrochloric acid, the free carbonic acid being expelled by boiling, and caustic soda is then added, which throws down all the uranium as sodium uranate with excess of alkali. The mixture is decanted, filtered, and washed very slightly on account of the ready solubility of sodium uranate in pure water; it is dried, the filter detached and burnt, its ash added to the precipitate, and the whole ignited at dull redness in a platinum crucible. When cold it is washed in cold water to remove excess of soda, filtered, dried, ignited, and weighed. We have thus a certain weight p of sodium uranate, $NaO,2N_2O_3$. The corresponding weight of U_3O_4 is found by calculation. The practical treatment of the ore comprises five operations:—Roasting the ore with sodium nitrate and carbonate, lixiviation of the roasted mass, treatment of the residues with sulphuric acid, precipitation of the foreign metals with sodium carbonate, and purification of the liquid and precipitation of the uranium. This precipitation is effected differently according as it is desired to obtain the product in a light yellow or the orange state. For the former the liquid is precipitated with caustic soda, until a portion of the liquid on acidulation no longer gives the red reaction with potassium ferrocyanide. To obtain the orange-coloured variety the carbonate of soda is very gradually neutralised with sulphuric acid, avoiding excess. The precipitation is complete. Six different preparations of uranium are produced —uranate of soda, of a light yellow, an orange, and a bright orange; uranate of potash, of a bright orange; uranate of ammonia, of a light yellow; and black uranium oxide. The vanadium present in the Joachimsthal ore does not exceed 0·1 per cent, and the methods tried for its extraction do not appear to have been commercially successful.

Les Mondes, Revue Hebdomadaire des Sciences.
No. 4, October 7, 1880.

On Sulpho-hydantoine.—R. Andreasch.—This compound, formerly prepared only by the contact of sulpho-urea with mono-chloro-acetic acid, may likewise be obtained by heating a mixture of cyanamide and thioglycolic acid.

On Matter Radiating from Electrodes.—Dr. J. Puluz.

MISCELLANEOUS.

The Brush Electric Light.—We learn that the electric lights, mentioned in our issue of January 21 (page 37) as in successful operation at the River Side Spinning Mills at Providence, New Jersey, are on the Brush System, not on that of Edison.

NOTES AND QUERIES.

Sulphur for Manufacturing Purposes.—Will any of your readers oblige by information concerning a new kind of sulphur coming into use in the manufacture of sulphuric acid, and where it may had?—A Subscriber.

MEETINGS FOR THE WEEK.

Monday, 14th.—London Institution, 5.
— Medical, 8.30.
— Royal Geographical, 8.30.
— Royal Institution, 3. "The Troubadours," Mr. F. Hueffer.
— Society of Arts, 8. "Watchmaking," by Edward Rigg, M.A.
Tuesday, 15th.—Royal Institution, 3 p.m. "The Blood," Prof. Schäfer.
— Civil Engineers, 8.
Wednesday, 16th.—Society of Arts, 8. "The Participation of Labour in the Profits of Enterprise," Sedley Taylor, M.A.
— Meteorological, 7.
Thursday, 17th.—London Institution, 7.
— Royal, 4.30.
— Philosophical Club, 6.30.
— Chemical, 8. Ballot for Election of Fellows. "On a New Apparatus for Showing the Dissociation of Ammonium Salts," D. Tommasi. "On the Estimation of Organic Carbon and Nitrogen in Water Analyses Simultaneously with the Estimation of Nitric Acid," Mr. W. Williams.
— Royal Institution, 3. "Drawing Room Music," Prof. Pauer.
Friday, 18th.—Royal Institution, 8. "Fruits and Seeds," Sir John Lubbock, 9.
— Geological (Anniversary), 8.
Saturday, 19th.—Royal Institution, 3. "Ancient Egypt," Mr. R. S. Poole.

SCIENTIFIC WORKS PUBLISHED BY MESSRS. LONGMANS & CO.,

DICTIONARIES AND ENCYCLOPÆDIAS.

DICTIONARY of CHEMISTRY and the ALLIED BRANCHES of OTHER SCIENCES. By HENRY WATTS, F.R.S., Editor of the Journal of the Chemical Society, assisted by eminent Scientific and Practical Chemists. 7 vols. 8vo., £10 16s. 6d.

THIRD SUPPLEMENTARY VOLUME, completing the Record of Chemical Discovery to the year 1877. In Two Parts. Part I. 8vo., price 36s. Part II., completion, in the Press.

GWILT'S ENCYCLOPÆDIA of ARCHITECTURE, Latest Edition, with Alterations and considerable Additions. By WYATT PAPWORTH. Additionally illustrated with nearly 400 Wood Engravings by O. Jewitt, and upwards of 100 other New Woodcuts. 8vo., 52s. 6d.

URE'S DICTIONARY of ARTS, MANUFACTURES, and MINES; containing a Clear Exposition of their Principles and Practice. The Seventh Edition, completely revised and greatly enlarged by ROBERT HUNT, F.R.S., Keeper of Mining Records, assisted by F. W. RUDLER, F.G.S., and by numerous Contributors. With above 2604 Woodcuts. 4 vols., medium 8vo., price £7 7s.

TEXT-BOOKS OF SCIENCE, MECHANICAL AND PHYSICAL,

FOR THE USE OF ARTISANS AND OF STUDENTS IN PUBLIC AND SCIENCE SCHOOLS.

Edited by C. W. MERRIFIELD, F.R.S.

ABNEY'S PHOTOGRAPHY, 3s. 6d.
ANDERSON'S (Sir J.) STRENGTH OF MATERIALS, 3s. 6d.
ARMSTRONG'S ORGANIC CHEMISTRY, 3s. 6d.
BALL'S ASTRONOMY, 6s.
BARRY'S RAILWAY APPLIANCES, 3s. 6d.
BLOXAM'S METALS, 3s. 6d.
GOODEVE'S MECHANICS, 3s. 6d.
GORE'S ELECTRO-METALLURGY, 6s.
GRIFFIN'S ALGEBRA and TRIGONOMETRY, 3s. 6d. Notes, 3s. 6d.
JENKIN'S ELECTRICITY and MAGNETISM, 3s. 6d.
MAXWELL'S THEORY of HEAT, 3s. 6d.
MERRIFIELD'S TECHNICAL ARITHMETIC, 3s. 6d. Key, 3s. 6d.
MILLER'S INORGANIC CHEMISTRY, 3s. 6d.
PREECE & SIVEWRIGHT'S TELEGRAPHY, 3s. 6d.
RUTLEY'S STUDY of ROCKS, or TEXT-BOOK of PETROLOGY, 4s. 6d.
SHELLEY'S WORKSHOP APPLIANCES, 3s. 6d.
THOME'S STRUCTURAL and PHYSIOLOGICAL BOTANY, price 6s.
THORPE'S QUANTITATIVE ANALYSIS, 4s. 6d.
THORPE and MUIR'S QUALITATIVE ANALYSIS 3s. 6d.
TILDEN'S CHEMICAL PHILOSOPHY, 3s. 6d.
UNWIN'S MACHINE DESIGN, 3s. 6d.
WATSON'S PLANE and SOLID GEOMETRY, 3s. 6d.

MILLER'S ELEMENTS of CHEMISTRY, Theoretical and Practical. Part I. *Chemical Physics.* Sixth Edition, revised, with Additions, by H. Macleod, F.C.S. With 274 Woodcuts. 8vo. 16s.

MILLER'S ELEMENTS of CHEMISTRY. Part II. *Inorganic Chemistry.* Sixth Edition, revised throughout, with Additions by C. E. Groves. With 376 Woodcuts. 8vo. 24s.

MILLER'S ELEMENTS of CHEMISTRY. Part III. Fifth Edition, revised, and for the most part re-written, by H. E. Armstrong, F.R.S., and C. E. Groves, F.C.S. The Chemistry of Carbon Compounds, or Organic Chemistry, in Two Sections. Section I.—*Hydrocarbons, Alcohols, Ethers, Aldehides,* and *Paraffinoid Acids;* with 20 Woodcuts. 8vo. 31s. 6d. Section II., completion, is in the press.

The ELEMENTS of MECHANISM. By T. M. Goodeve, M.A., Barrister-at-Law, Lecturer on Applied Mechanics at the Royal School of Mines. New Edition, re-written and enlarged; with 342 Woodcuts. Crown 8vo. 6s.

EXPERIMENTAL CHEMISTRY for Junior Students. By J. Emerson Reynolds, M.D., F.R.S., Professor of Chemistry, University of Dublin. Part I. *Introductory.* Fcp. 8vo. 1s. 6d.

DESCRIPTIVE and ANALYTICAL BOTANY. Translated from the French Work of DE CAISNE and LE MAOUT by Mrs. Hooker; edited and arranged by J. D. Hooker, M.D. With 5500 Woodcuts. Imperial 8vo., price 31s. 6d.

GANOT'S NATURAL PHILOSOPHY, for GENERAL READERS and YOUNG PERSONS: a Course of Physics divested of Mathematical Formulæ and expressed in the language of daily life. Translated by E. Atkinson, F.C.S. Fourth Edition. Plates and Woodcuts. Crown 8vo. 7s. 6d.

GANOT'S ELEMENTARY TREATISE on PHYSICS, Experimental and Applied, for the use of Colleges and Schools. Translated by E. Atkinson, F.C.S. Ninth Edition. Plates and Woodcuts. Large crown 8vo. 15s.

HEAT a MODE of MOTION. By John Tyndall, LL.D., D.C.L., F.R.S. Sixth Edition (Thirteenth Thousand), thoroughly revised and enlarged; with Frontispiece and 123 Woodcuts. Crown 8vo. 12s.

FRAGMENTS of SCIENCE; a Series of detached Essays, Addresses, and Reviews. By John Tyndall, LL.D., D.C.L., F.R.S. Sixth Edition, revised and augmented. 2 vols. crown 8vo. 16s.

A HANDBOOK of PRACTICAL TELEGRAPHY. By R. S. Culley, Member Inst. C.E., Engineer-in-Chief of Telegraphs to the Post Office. Seventh Edition, revised and enlarged; with 132 Woodcuts, and 18 Lithographic Plates of Apparatus. 8vo. 16s.

On ARTIFICIAL MANURES, their Chemical Selection and Scientific Applications to Agriculture; a Series of Lectures given at the Experimental Farm, Vincennes. By Georges Ville. Translated and edited by W. Crookes, F.R.S., V.P.C.S. With 31 Illustrations. 8vo. 21s.

London, LONGMANS, GREEN, & CO.

THE CHEMICAL NEWS.

Vol. XLIII. No. 1108.

ON THE

INFLUENCE OF THE MOLECULAR GROUPING IN ORGANIC BODIES ON THEIR ABSORPTION IN THE INFRA-RED REGION OF THE SPECTRUM.*

By Captain W. DE W. ABNEY, R.E., F.R.S., and
Lieutenant-Colonel FESTING, R.E.

The authors describe the apparatus used by them in their research and their plan of mapping the absorption spectra, the results being given in wave lengths. The source of light for obtaining a continuous spectrum was the incandescent positive pole of an electric light, the electricity being generated by a Gramme machine. The light was passed through tubes containing the fluid, and the absorption spectra photographed in the infra-red region.

The absorptions they met with they classed as follows:—

1st. General absorption at the least refrangible end of the spectrum.

Lines .. { Fuzzy.
Sharp.

Bands .. { Both edges sharply defined.
One edge sharply defined.
Both edges less sharply defined.

The authors next discuss the causes of the different absorptions met with in various fluids. From experiment they show that a large number of lines which are formed in hydrocarbons containing no oxygen are common to substances containing hydrogen and no carbon, and that in carbon tetrachloride and carbon disulphide, no lines or bands are to be met with. By this eliminating process they deduce the fact that the presence of lines is due to the hydrogen in the bodies. They show that the termination of the bands in liquids containing carbon, hydrogen, and oxygen corresponds with the position of these hydrogen lines. It therefore appears to them that the bands are in reality a blocking out of radiation between two hydrogen lines. By increasing the thickness of the fluid in front of the slit, the bands may be widened to another hydrogen line, each hydrogen line acting as a stepping-stone, or they may remain constant if both edges are defined, or they may be obliterated by general absorption. On the other hand, lines may be spread out to bands as the thickness of liquid is increased. When the thickness of the fluid is diminished the lines may disappear, and the bands become lines, or the bands may remain constant though fainter.

The authors then point out that each radical has its own definite absorption in the infra-red, and that such a radical can be detected in a more complex body. It also seems possible that the hydrogen which is replaced may be distinguiuhed by a comparison with other spectra: They next point out coincidences between some of the lines obtained, the absorption spectra of the hydrocarbons, and the spectra of bodies containing no carbon with solar lines, from which they reason that at present it is not safe to infer that such lines in the solar spectrum are not necessarily due to water. Whether the lines mapped are due to hydrogen or not, it is perfectly evident that every organic body has a definite absorption spectrum which connects it with some series. The paper closes with an appendix giving tables of the bands and lines found in the following substances, of which also there are maps —

Methyl iodide.
Ethyl iodide.
Propyl iodide.
Amyl iodide.
Phenyl iodide.
Ethyl bromide.
Amyl bromide.
Methyl alcohol.
Ethyl alcohol.
Propyl alcohol.
Isopropyl alcohol.
Isobutyl alcohol.
Pseudobutyl alcohol.
Amyl alcohol.
Diethyl ether.
Amyl ether.
Ethyl nitrate
Ethyl oxalate.
Ethyl sulphide.
Aldehyd.
Paraldehyd.
Formic acid.
Acetic acid.
Propionic acid.
Isobutyric acid.
Valerianic acid.
Glycerine.
Benzene.
Phenyl bromide.
Benzyl chloride.
Nitrobenzol.
Aniline.
Dimethyl aniline.
Turpentine.
Olive oil.
Aceto-acetic ether.
Diethyl aceto-acetic ether.
Benzylethyl ether.
Methyl salicylate.
Cinnamic alcohol.
Phenylpropyl alcohol.
Dibenzyl acetic ether.
Allyl alcohol.
Allyl sulphide.
Anethol.
Citraconic anhydride.
Water.
Nitric acid.
Hydrochloric acid.
Sulphuric acid.
Ammonia.
Chloroform.

---

* Abstract of a Paper read before the Royal Society, February 10, 1881.

LABORATORY OBSERVATIONS.

ON THE DETECTION OF SMALL QUANTITIES OF PLATINUM.

By FREDERICK FIELD, F.R.S.

It is well known that when potassic iodide is added in slight excess to a solution of platinic chloride, the platinic iodide is dissolved, and, should the solution be concentrated, a dark red liquid, almost approaching to black, is produced. It is not generally known, however, as far as I am aware, that very minute traces of platinum can be detected in this way, and in many cases where that metal is in combination with a very large excess of other metals it may be distinctly recognised. In order to show the delicacy of the test, 0·1 grm. of a platinum was converted into the chloride, evaporated carefully to dryness, care being taken that every trace of nitric acid was expelled. This was dissolved in a 1000 c.c. of water, each c.c. therefore containing 1-10,000th part of platinum, to which a drop of potassic iodide imparted immediately a dark rich rose-colour, strikingly resembling a concentrated solution of cobalt nitrate. 10 c.c. of this was made up to a litre (1000 c.c.), so that every c.c. contained 0·000001, or one-millionth of platinum. A portion of this liquid was transferred to a capacious beaker, and a solution of iodide added. It remained colourless for a few minutes, and then assumed a beautiful rose-coloured tint, very like that of a manganese salt. At the end of some hours the colour was very much intensified. At this state of dilution of platinic salts there is no apparent change effected by the introduction of sulphuric acid. The litre was made up to two litres, and the colour after some hours was distinctly observable. Thus it seems that *one* part of platinum in two *millions* of liquid can be detected by this test. It was observed that a drop or two of acid added to the solution accelerated the development of the colour. Upon further experiments it was proved that sulphydric acid, sodic sulphite and hyposulphite, sulphurous acid, mercuric chloride, and certain other reagents immediately destroyed the colour. Also, when the pink solution is heated the tint disappears. The sulphites and other deoxidisers doubtless convert the platinic salt into platinous, and the change of colour is thus explained. It is more difficult to understand the action of mercuric chloride. Heat, it may be surmised, produces a *disassociation*, the platinic iodide being thrown out of solution when so highly diluted, and the precipitate too minute to be discernible.* Further experiments were made upon the detection of platinum when in combination with other metals, and it may be stated that solutions were so prepared that the platinum was in the proportion to the others as one to a thousand, and in many cases much less.

Zinc and Platinum.—About 1 grm. zinc chloride was dissolved in 100 c.c. water, and a milligrm. of platinic chloride added. The rose colour was developed after a few minutes, on the addition of potassic iodide.

Iron and Platinum.—About the same quantity of both metals as above (the iron as a ferrous salt), dissolved in a similar amount of water, gave equally satisfactory results. When the iron exists in a ferric compound, the results are not satisfactory, as the platinic chloride on boiling with sulphurous acid (which is necessary to convert the *ferric* into the ferrous salt) is also reduced, and no colour is afforded on addition of the test.

Cadmium and Platinum.—Results perfectly satisfactory.

Manganese and Platinum.—Equally so.

Cobalt and Platinum.—Cobaltic salts, even when highly dilute, possessing a pink colour, the reaction of potassic iodide is not so conspicuous. If, however, the cobalt solution contains platinum, the introduction of the alkaline iodide imparts a far deeper tint. This can be satisfactorily shown by having two beakers of equal diameters, one with a solution of pure cobalt, the other with a solution of the same strength, to which a little platinum is added. Upon the addition of the iodide, the difference of colour between the two is sufficiently evident.

Nickel and Platinum.—The detection of platinum in nickel is not satisfactory, unless the solution be so dilute as to render the green colour of the nickel salt imperceptible. It is well known that dilute solutions of cupric chloride and potassium permanganate, or cobalt and nickel salts, when mixed in proper proportions, become almost colourless. The action of manganic oxide on common green glass in a state of fusion, and commonly known as glass-makers' soap, is doubtless owing, not to any definite action on the vitreous mass, but simply to the *neutralisation*, so to speak, of the green, by the amethyst, produced by the manganese. Hence the rose colour of the platinum is disguised by the green of the nickel.

Solutions were made of silver, lead, iron (ferrous), mercury, cadmium, cobalt (in small quantity), and zinc. A minute trace of platinum was added, and a drop or so of the iodide. The pink colour was at once apparent. Nickel was added to another portion of the liquid, but the iodide in this instance produced no change, except, perhaps, a dull grey colour.

Lead and Platinum.—When potassic iodide is added to a solution of these metals, the production of lead iodide somewhat interferes with the result. It is always better to add previously, dilute sulphuric acid or a sulphate of one of the alkali metals, and allow a complete precipitation of the lead sulphate. Very minute traces of platinum can now be detected.

Copper and Platinum.—As potassic iodide precipitates cuprous iodide from cupric solutions, the test in this instance cannot be directly applied. A solution containing the two metals, and free from nitric acid, may be precipitated by zinc, and the metallic deposit digested in dilute nitric acid, which will dissolve the copper, leaving a slack powder of platinum. This, dissolved, with the necessary precautions, gives the characteristic colour on the addition of the iodide.

Mercury and Platinum.—On the cautious addition of the iodide, the red precipitate of the mercuric iodide is redissolved in the excess of the mercuric chloride (if that salt has been used), and the solution remains colourless, for, as it has been previously stated, mercuric chloride destroys the rose colour of the platinum compound. On further addition and slight agitation, the whole of the mercuric iodide is precipitated and the supernatant liquid is pink. To avoid filtration, more iodide may be added until the mercuric iodide is entirely dissolved.

Silver and Platinum.—There is no difficulty in the dilution of minute traces of platinum in silver. The latter metal is first removed by a soluble chloride, and the platinum detected in the usual manner. A still simpler method is to add excess of potassic iodide to the solution. The silver is entirely precipitated, and a supernatant rose-coloured liquid is discernible.

Bismuth and Platinum.—The detection of platinum in bismuth by this process is not satisfactory.

Gold and Platinum.—Auric chloride has a very strong colouring power. A drop of a moderately strong solution of this salt imparts a bright yellow to a thousand times its volume of water. The colour is exceedingly intensified by auric iodide, or rather a solution of auric iodide in potassic iodide. When this last-named salt is added to a solution of gold which is so weak as to impart no perceptible colour, a yellow tint appears. As this yellow would very much disguise the rose of the platinic compound, it is necessary to remove the gold before the application of the test. This is easily effected by the addition of an excess of oxalic acid, the gold is precipitated, and the colour on the addition of potassic iodide is developed. One part of platinum in a thousand parts of gold is readily detected by this means.

Palladium and Platinum.—It is difficult to detect platinum in the presence of palladium by potassic iodide, for this salt appears to dissolve palladious iodide, although it would seem the latter is always in very minute mechanical division, for the brownish red liquid, apparently perfectly clear and bright, becomes colourless after a few days, and a mirror of the iodide is seen on the sides of the vessel. Long practice, perhaps, might enable one to distinguish the difference between the two iodides, but the test cannot be considered as reliable in this instance.

Rhodium and Platinum.—As the salts of rhodium have as nearly as possible the same colour as the solutions of platinic or potassic iodide, the test is also in this case inadmissible.

My observations have extended to the action of certain organic substances upon the "rose colour" so often mentioned in the above paper, and I believe they are not altogether without interest to the chemist.

HOW IS PETROLEUM TO BE EXAMINED?

By F. SKALWEIT.

The various results obtained these last two years by several chemists who have examined the same petroleum with a view to ascertain how far it is fit or unfit for a given purpose, induced me to look for other means than those used up to the present day, in order to discover the degree of its inflammability and its defective qualities.

The first thing to be done was to exactly determine its specific gravity and its boiling-point. Thus it was found that the various kinds of petroleum which, at a lower point of temperature, develop inflammable gases, have a specific gravity under 0·800 and even 0·789, whereas good sorts are considerably heavier, and rise to 0·824. The boiling-points, also, are considerably lower; and it is clear that the inflammability of such petroleum depends, to some extent, on its boiling-point, as follows:—

		Igniting-point.
First change from carbd. hydrogen at	100° C.	22°
,, ,, ,,	108	24
,, ,, ,,	121	26
,, ,, ,,	126	25·5
,, ,, ,,	130	30
,, ,, ,,	133	31
,, ,, ,,	138	35
,, ,, ,,	141	37
,, ,, ,,	180	65

---

* Experiments have been made recently upon these rose-coloured solutions, which will shortly be communicated.

The latter petroleum is sold here in Hanover under the name of "Safety Oil" (*Sicherheits öl*), and is obtained from the factory of Dr. W. H. Lepenau, of Salzbergen. According to these experiments, petroleum, which in the usual process of distillation develops inflammable hydrogen gases at 140° or lower, will probably not answer the requirements of the English law, which prescribes that petroleum shall emit inflammable gases at 38° C. only. This has, up to now, been the case with the various kinds of petroleum which have come within my observation. Many more experiments will be necessary to be able to legally determine the lowest permissible boiling-point instead of the igniting-point. Should this become feasible, the matter would be greatly simplified, to the general satisfaction of most chemists. Whatever may be said to the contrary, all the apparatus which have been used up to the present day to fix the igniting temperature require that the experimentalist shall work his apparatus for some days at least before he can obtain concordant results; they pre-suppose constant practice and proper management.

I hoped, however, to find a simpler way than that of determining the specific gravity and boiling-point in fixing the angle of refraction; and as I have, for several years already, consulted Abbé's refractometer in examining crude glycerin and oil, I made use of the same for analysing petroleum. The experiments were made at a temperature of 17° to 18° C. The index of the alidade was so adjusted that water of 17° to 18° C. showed an average of $n = 1{\cdot}3330$ from both results.

Specific Gravity.		Distillation.	Index of Refraction.	Igniting-point.
0·7942	to	130° — 1 %	1·4431	29° C.
0·8242		180 — 0 %	1·5549	65
0·7920		110 — 2 %	1·4265	24
0·7930		not quoted	1·4289	28
0·7937		132° — 1 %	1·4320	32
0·8012		141 — 1 %	1·4489	38

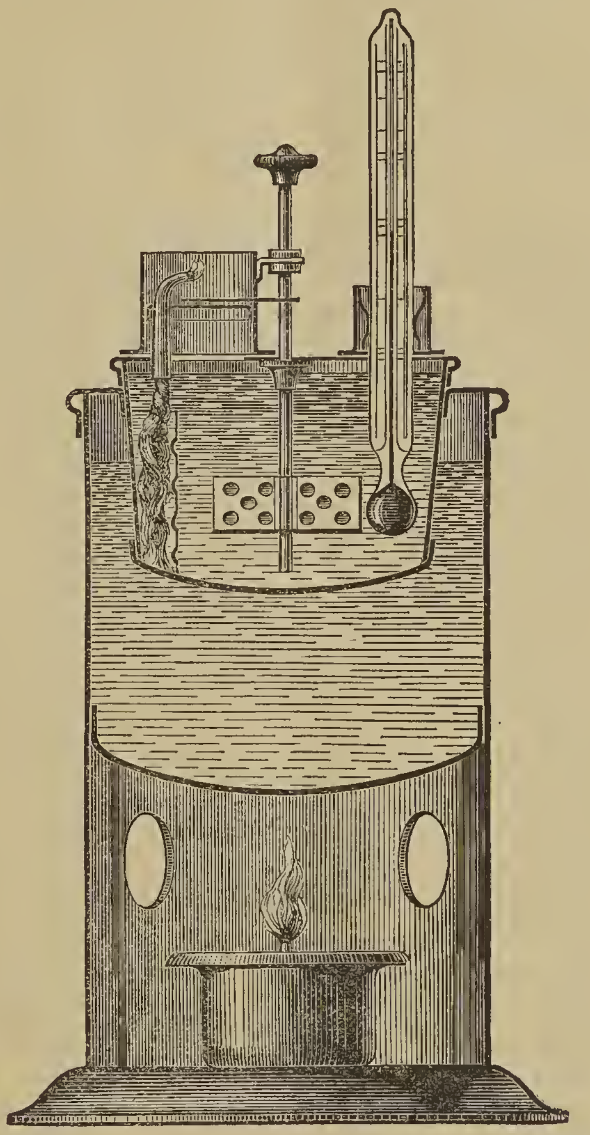
These few data, which might be considerably increased' show at a glance a great difference in the index of refraction with various kinds of petroleum; but its irregularity in rising and falling, compared with the igniting-point, is also exhibited. The igniting-point concurs most with the specific gravity and the boiling-point. This becomes particularly evident when the distillates of petroleum, boiling at a low point, are separately examined.

				Index of Refraction.
For the distillation	between	100°—	110° C.	1·3991
,,	,,	110	120	1·4033
,,	,,	120	130	1·4087
,,	,,	130	140	1·4101
,,	,,	140	150	1·4125
,,	,,	150	160	1·4151
,,	,,	160	170	1·4179
,,	,,	170	180	1·4205
,,	,,	180	190	1·4239
,,	,,	190	200	1·4279
,,	,,	200	210	1·4308
,,	,,	210	220	1·4332
,,	,,	220	230	1·4359
,,	,.	230	250	1·4395
,,	,,	250	280	1·4458

According to these examinations, petroleum, for which a specific gravity of above 0·800 and an igniting-point of 38° C. is sufficient, has an angle of refraction of 1·4489. With some practice the last examination is very simple, and requires a few minute's time only. Most chemists are likely to prefer it to any other process, for, as it is, it gives a clue to find out its usefulness or its defectiveness. If, however, in examining petroleum its physical properties are entirely left aside, and importance is attached solely to its quality of igniting and burning, the apparatus must be self-acting and sufficiently safe.

From several hundreds of experiments I may perhaps infer that the many apparatus which have been in use up to the present day do not answer the purpose. I would not, therefore, venture to increase their number by one were I not induced to do so by several chemists of the province of Hanover, who for some time already have, to their greatest satisfaction, worked with my petroleum tester, and were I not convinced that this little apparatus—which, thermometer included, costs here in Hanover only 5 marks (5 shillings)—fully answers its purpose. The same advantage cannot be expected even from the best and most expensive apparatus known.

The accompanying diagram, half natural size, plainly exhibits the simplicity of its construction.



A small petroleum cistern containing 120 c.c. has inside a small perforated petroleum chamber with a soldered edge, by which it hangs on a water vessel of 300 c.c. The one fixes the other. The lid of the petroleum cistern has a rectangular edge, and is closed by an iron stang fixing the lid with the cistern. In the lid four parts are to be noticed:—(1) A cap of 2 c.m. high; (2) a mixing rod with knob; (3) a small brass plate: (4) an aperture for the thermometer. The cap has, 1 c.m. above the lid, a brass disconnecter: in its centre is a little hole, which is closed by means of a thin brass plate moving on the disconnecter. The object of the brass disconnecter is to fix a small tube, in which is placed a cotton wick. By adding that under the water vessel there is a good spirit-lamp, I complete the description of the apparatus.

The petroleum to be examined fills the vase up to the edge of the interior chamber which is to receive the cotton wick. The lid being put on, the spirit-lamp is lit along with the little lamp in the cap. The knob is now to be turned from time to time, and the thin brass plate to be drawn out. Nothing else is required. In about ten minutes the examiner will have ascertained the inflammability (flashing-point) of the petroleum. For the very moment inflammable gases begin to issue through the aperture under the little flame they ignite, and the flame is extinguished with little loss. The spirit-lamp is then to be put out, the lid to be removed, and the thermometer to be placed in the petroleum chamber now prepared for it. Now and then a burning match is quickly brought in contact with the petroleum, and, after blowing it out, the igniting temperature is read, when the whole surface will be in a blaze and continue burning.

The experiments made with this apparatus by several chemists have produced the most favourable—and in each case invariable—results.

DECOMPOSITION OF SLAGS AND SILICATES

By MALVERN W. ILES.

The well-known method of fusing finely-divided silicates with sodium or potassium carbonate in a platinum crucible over a blast-lamp has generally no special objections. There are, however, laboratories connected with technical works so located that gas cannot be obtained, hence blast-lamp fusions cannot be resorted to. Slags containing lead, as in the treatment of lead ores by the blast-furnace, should not be fused in a platinum crucible, even when the slag shows as low as 1 per cent of lead by fire assay, and even when a large excess of flux is used.

The method I have to suggest originated from a long-felt desire for a rapid and accurate decomposition of lead slags, in the performance of a complete analysis.

The mode of procedure may be stated as follows:—

From 45 to 50 grms. pure potassium hydroxide are fused in a large silver crucible until the mass has assumed a quiet fusion. (Capacity of crucible 70 c.c. water.) Upon the surface of the cooled mass, 1 grm. finely-powdered silicate is introduced, and the heat is gently applied, increasing the heat toward the end of the fusion, which rarely exceeds thirty minutes.

Manganate, silicate, and aluminate of potassium will be found, and the iron will remain as a sesquioxide; in short, much the same chemical reactions will ensue as when fusion is made in a platinum crucible with carbonates of the alkalies.

There is, however, a marked difference in the time required for the performance of the process, and the rapidity of the disintegration of the fused mass when treated with water. The lead will not attack the silver crucible in the slightest degree, which is not the case when platinum vessels are used, as has already been indicated.

After the fusion has been completed, the crucible is allowed to cool and introduced into a vessel containing just suffient water to cover the crucible, and the mass allowed to dissolve. The silicic acid is then separated as usual. It must be remembered, however, that fused potassium or sodium hydroxides will slightly attack silver vessels, and one must take the precaution to wash the silicic acid with some one of the well-known solvents for argentic chloride, as strong ammonia or sodium hyposulphite. This, however, is rapidly and completely performed.

The above mode of procedure has the following advantages:—

1. Rapidity of execution.
2. Complete decomposition.
3. Obviates the use of gas.
4. Replaces the expensive platinum crucibles by less expensive ones.
5. Less liability to loss in the performance of the operation; since by dehydrating the potassium hydroxide before beginning the operation, it then continues quietly to its completion.

It need scarcely be mentioned that this method suggests a mode for the separation of aluminium from iron; also a volumetric method for the determination of manganese, since potassium manganate is quite stable in an excess of caustic alkalies.—*Engineering and Mining Journal.*

Chemical Laboratory, Grant Smelting Co.,
Leadville, Colo.

ON THE
LOSS OF NITROUS COMPOUNDS IN THE MANUFACTURE OF SULPHURIC ACID, AND ON A METHOD FOR THEIR ABATEMENT.

By MM. LASNE and BENKER.

In the ordinary working of vitriol-chambers provided with the Gay-Lussac tower there is lost a certain quantity of nitrous compounds, which involves a corresponding consumption of nitrate of soda or nitric acid. Having studied the cause of these losses, we have succeeded in reducing them to the third part of what they reach in the best conducted establishments. The only really important loss is that produced by the proportion of hyponitric acid in the gases which have traversed the Gay-Lussac tower and escape into the atmosphere. The gases which issue from the lead-chambers ought to contain at least 5 per cent of oxygen in excess, which is necessary in order that the oxidation of the sulphurous acid may be complete. We are led to admit that in presence of this quantity of free oxygen the nitrous compounds are in the state of hyponitric acid. On the other hand, it is understood that the sulphuric acid, charged with nitrogen products on its passage through the towers, contains exclusively nitrous acid. We have verified this fact by repeated experiments under the most varied circumstances which the progress of the works permitted. Here is therefore an apparent contradiction which has struck us, and for which we have sought an explanation. The hyponitric acid dissolves in sulphuric acid at sp. gr. 1·689, and can combine with it under certain circumstances. But these compounds have little stability, and their tension of dissociation is very great, even at common temperatures, so that the passage of a current of dry air or of carbonic acid liberates the hyponitric acid entirely, and unchanged. A slight rise of temperature accelerates this liberation. In the gaseous mixture which enters the towers the hyponitric acid occupies merely 3-1000th parts of the total volume. Its tension, therefore, is very slight, and it may be conceived that the sulphuric acid cannot retain it in important quantities. Thus we do not find it in sensible quantities in the air which flows from the apparatus.

Nitrous acid behaves very differently: it forms with sulphuric acid a definite and stable compound, which is not destroyed by the action of a moderate heat, nor even by a current of sulphurous acid. It is only by dilution with water that we can decompose this nitroso-sulphuric compound, known as "chamber crystals." Nitrous acid when it has once combined with sulphuric acid is therefore fixed, but it remains to be explained how nitrous acid is formed in the towers. Various practical observations have given us a clue. We have remarked that the proportion of nitrous acid flowing from the towers is so much the lower as the working of the chambers is more nitrous—a fact which appears anomalous. The loss of nitrous products diminishes in the same porportion as the intensity of colouration of the gases entering the tower. On examining these gases carefully we have always found there the presence of a quantity of sulphurous acid, very slight but variable, the co-existence of which with sulphuric acid can only be due to the imperfection of the mixture. Such are the facts which have furnished us with the explanation sought for. The gases in this place are almost dry, but not absolutely so. The sulphurous acid meeting with hyponitric acid reduces it. This reduction, however, stops at nitrous acid, because this product as soon as formed combines with the sulphuric acid produced at the same time, and yields the stable compound nitroso-sulphuric acid. The reaction takes place between two equivalents of each of these two bodies. One equivalent of nitrous acid is retained whilst the other escapes, to become oxidised afresh, and recommence a little further the same reactions. The sulphuric acid which moistens the coke in the tower has the effect of re-collecting the nitro-sulphuric acid formed in the gases, dissolving it, and bringing it to the bottom of the tower. It has no chemical action except iu the exceptional cases where it meets with pre-formed nitrous acid. The nitroso-sulphuric acid being ualterable, the nitrous products are henceforth secure from all attacks. We have pointed out that there remains in the gaseous mixture a very slight quantity of watery vapour. This condition is necessary, as sulphurous and hyponitric acids when perfectly dry do not react with each other, the nitroso-sulphuric compound containing combined water. On the other hand, a slightly larger proportion of water destroys the compound.

If the recovery of the nitrous products is more complete when the gases are scarcely yellowish, this depends on the fact that they contain a proportion of sulphurous acid nearer what ought to be the case. But it is impossible to maintain this state in practice, the least influence modifying it, and rendering it either nitrous or sulphurous, and causing losses in either case. We are led to go on with an excess of nitrogen products, and to lose the quantity of hyponitric acid which has not met with sulphurous acid to combine with. We may therefore say that the weight of the nitrous products retained is proportional to the quantity of sulphurous acid co existing in the gases at their entrance into the Gay-Lussac condensers.

If this is the case, it is sufficient to restore the just proportion by the direct injection, at the foot of the tower, of sulphurous acid in a suitable hygrometric state, so that the reactions may be complete. The gases then become simultaneously poorer in sulphurous and hyponitric acids, in consequence of the greater and greater perfection of the mixture and of the repeated contacts with acid at 1·689 sp. gr., and if the proportions are well regulated they contain at their exit merely absolutely insignificant traces of either of these two bodies. Such are the conditions which we have realised, and experience has fully confirmed our forecasts. We have thus succeeded in reducing the expense of nitrate to the third of what it had been previously.

The object we had in view was thus attained, but we soon found that the use of this process gave rise to other advantages of great importance. We were no longer liable to those losses which are incurred in working with an excess of nitrous vapours, since we were able to re-establish the equilibrium in the composition of the gases at any given moment. It results that we could expedite the reactions, obtain the highest possible yield of sulphuric acid, and increase the weight of pyrites burnt in a plant of a given size. Thus, at the Javal Works, where we made these trials, we succeeded in burning 2·400 kilos. pyrites per cubic metre of chamber-room, without injuring the yield of sulphuric acid or increasing the outlay in nitrate. —*Comptes Rendus*.

Researches on the Relative Intensities of the Rays of Hydrogen and Nitrogen: Application to the Constitution of the Nebulæ.—C. Fievez.—The characteristic rays of the spectra of gases disappear one after the other on gradually reducing the intensity of the light. With hydrogen the rays H and C disappear successively; F remains alone. With nitrogen Plücker's groups I., III., V., II., disappear, and the spectrum is reduced to the group IV., which, with the ray F, constitutes the spectrum of the nebulæ.—*Les Mondes*.

SODIUM HYDROSULPHITE, AND ITS APPLICATION IN THE QUANTITATIVE DETERMINATION OF THE DISSOLVED OXYGEN IN WATER, OF COPPER, OF INDIGO, AND OTHER COLOURING MATTERS.

By A. BERNTHSEN.

The composition of the hydrosulphite is not yet demonstrated to be in accordance with the formula SO_2NaH. It is more probable that the sulphur is present as—

$$SO_2H_2(=SO+H_2O),$$

just as in hyposulphurous and pentathionic acids.

The crude solution of hydrosulphite is already utilised in indigo-dyeing, and is applied in several analytical processes. The method proposed by M. A. Müller (*Bulletin Soc. Ind. Mulhouse*, 1874, 22), for the quantitative determination of indigo, is based upon the reduction of indigo-carmine by means of this salt, as also is the process for estimating the quantity of free oxygen dissolved in water, as devised by Schützenberger and Risler, and improved by Tiemann and Preusse. Cupric salts in ammoniacal solution, are reduced by hydrosulphite, first to cuprous salts (or on further addition to copper hydride and sulphide). The chemists above mentioned, therefore, determine the standard of the hydrosulphite solution by titrating it with a solution of copper sulphate containing excess of ammonia. According to Schützenberger hydrosulphite may also be used for the volumetric determination of copper in cupric salts.

I have also made use of this method of titration by means of an ammoniacal solution of copper, in the frequent determination of the actual proportion of hydrosulphite in a solution. Its admissibility seems to me, however, doubtful, as I found that the hydrosulphite solutions prepared according to Schützenberger, according to my experiments, contained relatively large quantities of sulphite and hyposulphite, both which salts have a reducing action upon copper oxide. It appeared that the addition of a large excess of a sulphite or hyposulphite certainly effected a considerable decrease of the proportion of oxide in a copper solution or even produced complete reduction. But under the circumstances which come into play in the titration, such a disturbing action does not prevail, because the duration of the reaction of the salts is too short, the large excess requisite is not present, and lastly, because the hydrosulphite acts immmediately reductive. Experiment showed that the error occasioned by the presence of sodium sulphite and hyposulphite scarcely exceeds the limit of errors of observation. Another circumstance was calculated to make the results of a hydrosulphite titration by means of a copper solution less accurate—the difficulty of observing the final reaction with sufficient distinctness. According to Tiemann and Preusse, the hydrosulphite should be run into the copper solution (in an atmosphere of hydrogen) till the colour completely disappeared, the oxide being entirely reduced to suboxide (*Berichte*, xii., 1777). The final point is said to be distinctly perceptible. According to another statement (*Bulletin Soc. Chimique*, xx., 145), the appearance of a faint yellowness,—the begining of the separation of copper or copper hydride—shows the final reaction. To reach this point, 0·1 to 0·2 c.c. hydrosulphite solution must be added after complete decolouration.

I did not succeed in obtaining concordant results in this manner, since the end of the reaction, total decolouration, was not readily to be distinguished, and the yellow tint sometimes appeared only on the addition of a decided excess of hydrosulphite. Goppelsröder, in his critique on Müller's process (*Bull. Soc. Ind. Mulhouse*, 1873, 643), observed that the quantities of hydrosulphite consumed in decolourising 20 c.c. of the copper solution varied by 0·5 to 1·6 c.c., equal to 4 to 15 per cent. He therefore proposed to determine the value of the hydrosulphite by means of permanganate, which oxidises it to sulphuric acid, and in this manner he obtained concordant figures. F. Mohr, J. König, and C. Krauch employ iron-ammonium alum instead of the copper solution. The liquid is coloured red with potassium sulphocyanide and becomes colourless on the completion of the reduction. As I have found that the hydrosulphite solution contains also sulphites and hyposulphites, it is plain that the use of permanganate for the determination of its value must lead to totally false results. Special experiments must decide how far iron-ammonium alum may be fit for use under these circumstances.

I have succeeded in modifying the titration of hydrosulphite with copper solution in such a manner that the final reaction can be conveniently and distinctly observed. The preparation of the standard liquids is the same as recommended by Tiemann and Preusse, and the apparatus employed is very similar to theirs. The hydrogen, after passing through a U-tube containing ferrous oxide enters a three-necked bottle holding about 200 c.c. on one side and takes its exit on the other side through a tube which passes in a little below the cork, bends down again and passes to the bottom of a small test-tube, which is firmly fixed to the apparatus and filled with water. In the central tubulure of the bottle is a caoutchouc stopper with two perforations, in which are secured two glass tubes, narrowed below and fitting well. These are connected with two burettes by means of flexible tubes, 2 c.m. in length, fitted with glass-rod pinch-cocks. In this manner the vessel is movable and its contents may be shaken. The one burette is filled with a dilute solution of indigo-carmine (Tiemann and Preusse's strength). The latter burette is connected above with a flexible tube leading to the gas-tube, and a tube joined to it laterally below, enables it to be filled with fresh hydrosulphite from a store-bottle also connected with the the gas. The gas employed must pass through a tube charged with pumice and ferrous oxide. 15 or 25 c.c. of copper solution are put into the three-necked bottle, the caoutchouc stopper is put in its place, the bottle is filled with hydrogen, and hydrosulphite solution is then gradually run in till the liquid is scarcely blue. A drop or a few drops of indigo-solution are then added from the other burette. The liquid takes a dirty blue colour, and on the further addition of hydrosulphite, this colour is suddenly and sharply changed by the last drop to a pure light yellow. There is no turbidity or precipitation.—*Berichte der Deutsch. Chem. Gessellschaft.*

THE TITRATION OF HYDROSULPHITE BY MEANS OF INDIGO-CARMINE, AND THE QUANTITATIVE DETERMINATION OF INDIGO BY MEANS OF HYDROSULPHITE.

By A. BERNTHSEN and A. DREWS.

For the titration of sodium hydrosulphite a dilute solution of extract of indigo may be used instead of an ammoniacal solution of copper. It is decolourised by hydrosulphite, its deep blue colour passing into a pale yellow, more or less pure. The change of colour, after a little experience, is easily recognised; solutions which are nearly neutral pass from blue through greenish to yellow; but if alkaline they become first violet, then red, and lastly yellow. M. A. Müller proved that in this reaction sodium hydrosulphite converts indigo extract quantitatively into sodium disulpho-leukindigotate. He also ascertained that to decolourise two molecules of copper sulphate the same quantity of hydrosulphite solution is required as to convert one molecule disulphindigotic acid into the corresponding leuco-compound. The authors confirm this statement.

It is most convenient to determine the strength of the indigo solution, prepared from 100 grms. commercial extract of indigo and 2 litres water, with a hydrosulphite solution of known strength. Thus if 20·41 c.c. of indigo solution require 13·3 of a solution of hydrosulphite, of which 35·75 c.c. decolourise 20 c.c. of a solution of copper (4·5346 grms. $CuSO_4+5aq$ in 1 litre), 1 c.c. of the indigo solution corresponds to 0·456 m.g. hydrosulphite if we accept the formula SO_2Na_2.

Or we may dissolve 1·191 grm. of dry chemically pure indigotin in a minimum of sulphuric acid, neutralise with sodium carbonate, and dilute to 1 litre. 2 c.c. of this solution correspond to 1 m. hydrosulphite. This method is rather inconvenient, because in using a minimum of sulphuric acid a portion of the indigo may remain unacted upon, or may form the sparingly soluble mono-sulphindigotic acid, whilst in presence of more sulphuric acid the sodium sulphate formed by its neutralisation is apt to cause a partial precipitation.

With respect to the details of the execution of the process the authors refer to the memoir of Tiemann and Preusse (*Ber. der Deutsch. Chem. Gesell.*, xii., 1868). The apparatus employed is the same as the one above described for the titration of copper, and the operation is conducted at a temperature of 40° in an atmosphere of nitrogen, from 30 to 40 c.c. of recently boiled water being first run in. Several successive determinations can be made without renewing the water, and the modification of the process suggested by König and Krauch obviates the trouble of emptying the Woolfe's bottle and re-filling with hydrogen.

The utility of the process for the determination of commercial indigo has been carefully tested. The great untrustworthiness of the oxidation process depends on the uncertainty how oxidising agents, *e.g.*, permanganate, behave with the organic matters present in crude indigo. A similar doubt obtains concerning the reduction process with hydrosulphite. The authors examined three samples of indigo (*a*, *b*, *c*), dissolving them first in sulphuric acid, and calculating the proportions of indigo from the quantity of hydrosulphite consumed. Portions of the indigo solutions were then used for dyeing wool so as to exhaust the colour, and the residual liquids were again titrated with hydrosulphite: *c* showed 71·7 per cent of indigo, *b* 97·5 per cent; *a* could only be determined very approximately, owing to the presence of dark colouring matters, not decolourised by the hydrosulphite, which masked the final reaction. The residual liquids left from dyeing wool were faintly yellow in case of *b* and *c*, and reddish brown in *a*. Their action upon hydrosulphite was quite insignificant. Admixtures other than dyes do not, therefore, in the hydrosulphite process require to be taken into account as possible sources of error.

The leukindigotic solutions produced by titration—the concentration being equal—appear darker the more impure the indigo, so that the hydrosulphite is probably without action upon the other colouring matters which accompany indigotin. Titration with hydrosulphite, therefore, may show the true proportion of indigotin in indigo. But as the other colouring matters which accompany indigo in commercial samples have a decided effect upon the value of the shades produced in dyeing, the common method of swatch-dyeing must be pronounced the only process which leads to practical results.

In case of homogeneous colouring matters which are contaminated merely with non-tinctorial substances, such as heavy spar and starch, the determination with hydrosulphite is to be recommended, and its applicability to the commercial testing of aniline colours deserves examination.—*Berichte der Deutschen Chemischen Gesellschaft.*

Rufigallic Acid and Oxyquinon.—Dr. J. Schreder.—The fusion of rufigallic acid with 6 parts of caustic potassa takes place less tumultuously than was affirmed by M. Malin, and does not yield a notable quantity of humous matters. Several substances are obtained by fractional crystallisation, and by the precipitation of the ethereal extract by a salt of lead. The least soluble of these bodies is oxyquinone.—*Les Mondes.*

PROCEEDINGS OF SOCIETIES.

PHYSICAL SOCIETY.

Saturday, February 12, 1881.

Prof. W. G. Adams in the Chair.

This being the annual general meeting the yearly report was read by the Chairman. The report showed that the Society now numbered 321 Members as against 298 of last year. Two eminent Members, Sir T. H. Elliot and the Rev. Arthur Rigg, had been lost by death. The Society had decided to republish the scientific papers by Dr. Joule in a collected form.

Dr. Atkinson, Treasurer, read the balance-sheet for the past year, which showed the Society to be flourishing.

The new Council and Officers where then elected, Sir W. Thomson retaining the Presidency. Mr. Bakewell and Herr G. Wiedemann were created Honorary Members. Votes of thanks were passed to the Lords Commisioners of the Council on Education for granting the use of the meeting-room to the Society; to Prof. Adams; to Dr. Guthrie, the Demonstrator; the Auditors; and the Secretaries, Profs. Reinold and Roberts.

The meeting was then resolved into a special general meeting, and a resolution put and carried, giving the Council power to invest money of the Society in the name of the Society, or of persons appointed by them, in certain Stock, home and foreign.

The meeting was then constituted an ordinary one, and Mr. T. Wrightson, C.E., read a paper by Prof. Chandler Roberts and himself "*On the Density of Fluid Bismuth.*" By means of the oncosimeter—an instrument which records on a band of paper the sinking or floating effect of a ball of the solid metal immersed in the molten metal—they had determined the density of fluid bismuth, from six experiments, to be 10·055. A former value by a different method was 10·039.

In the discussion which ensued Mr. Wrightson stated that his experiments proved solid cast-iron to be heavier than fluid, and to sink in the latter when first immersed, but it rapidly became lighter as the temperature rose till it floated when in its plastic state, and was consequently lighter than when in the molten state. The oncosimeter could be utilised for determining the change of volume in melting rocks, and Prof. Chandler Roberts suggested that it might throw light on the difference of state between the carbon of grey pig and white iron.

Dr. O. J. Lodge exhibited working models showing the hydrostatic analogies between water and electricity. A battery was represented by a pump, conductor by open pipes, dielectrics by a pipe closed by an elastic membrane, and electrometers by pressure-guages. With these analogues he showed the action of a Leyden jar, and the passage of telegraphic signals along a cable.

CORRESPONDENCE.

SOCIETY OF CHEMICAL ENGINEERS.

To the Editor of the Chemical News.

Sir,—In reply to your correspondent "J. H." (Chemical News, vol. xliii., p. 59), will allow me to state that at the last general meeting, held at the Victoria University, a sub-committee was appointed to draw up rules, &c., and to make preparations for holding the inaugural meeting in the spring. If J. H. will send me his address, I shall be happy to let him know when this meeting will be held.—I am, &c.,

George E. Davis, Hon. Sec. *pro. tem.*

Heaton Chapel, February [illegible]o.

BLEACHING-POWDER.

To the Editor of the Chemical News.

Sir,—In reply to Mr. Kingzett's questions (Chemical News, vol. xliii., p. 59), I beg to state that I am endeavouring once more to get his crystallised calcium hypochlorite, by minutely observing his prescriptions. The results will be mentioned when I publish the experiments on bleaching-powder now going on in my laboratory.

I still fail to see how the strictest proof of the existence of calcium hypochlorite in solutions of bleaching-powder, can be quoted as proving the formula of Odling, which does *not* assume that compound in dry bleaching-powder, against that of Gay-Lussac, which *does* do so. But further discussion on this point seems to me to possess but little interest for your readers.—I am, &c.,

George Lunge.

Zürich, Feb. 11, 1881.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, l'Académie des Sciences. No. 3, January 17, 1881.

Contemporaneous Production of Native Sulphur in the Sub-soil of Paris.—M. Daubrée.—Abundance of native sulphur has been found in the soil in certain excavations which have been lately made in the Place de la Republique. The origin of this substance is perfectly independent of the escape of coal-gas, and is evidently due to the simultaneous presence of gypsum and of organic matter of various kinds.

Production of Intermittent Signals by means of the Electric Light.—E. Mercadier.—This memoir requires an illustration which appears to have been omitted.

Observations on a Recent Communication by M. Dunand on a Process for Reproducing Speech by means of Electric Condensers.—C. Herz.—A claim of priority.

Certain Facts towards the History of Nitrification. MM. Hautefeuille and Chappuis.—Effluves corresponding to very feeble tensions are capable of forming nitric acid as the ultimate product of the decomposition of pernitric acid.

Studies on the Peat of the Crystalline Soils of Finistère.—M. de Molon.—The author has examined this peat as a material for the production of lighting-gas. He distils the peat in a vacuum at 300°, and under the influence of a current of superheated steam. The yield per 100 kilos. of peat was:—

Paraffin and pseudo-paraffin	8·840
Light oil (benzene, toluene)	1·100
Photogenic oil	4·732
Crude phenols	2·000
Resinous matters, methylic, and aromatic products, pitch, &c.	2·740
	19·412

Charcoal, per 100 kilos. of turf.. ..	45	kilos.
Sulphate of ammonia, per 1000 kilos.	10	"
Monohydrous acetic acid " "	11 to 12	"

Portions of the Pancreas Capable of Acting as Ferments.—A. Béchamp.—All the known properties of the pancreas are concentrated in certain microzymas.

No. 4, January 24, 1881.

Theory of Heat.—H. Resal.—A mathematical paper, not capable of useful abstraction.

Selection of the Unity of Force in Absolute Electric Measurements.—M. Lippmann.—The author considers that in some cases the dyne presents no essential advantage. It is very desirable that the units which serve to measure time, lengths, and forces, should be the same in electricity as in the rest of physics. It is suggested that electricians should take as fundamental unities the second, the metre, and the gramme.

Laws of the Disengagement of Electricity by Pressure in Tourmaline.—MM. Jacques and Pierre Curie.—The authors announce the following laws as resulting from their experiments:—The two ends of a tourmaline evolve quantities of electricity respectively equal, but of opposite signs. The quantity liberated by a certain increase of pressure is opposite in its sign, but equal to that produced by an equal decrease of pressure. This quantity is proportional to the variation of the pressure, independent of the length of the tourmaline, and for one and the same variation of pressure per unit of surface it is proportional to the surface.

Baryta employed in Obtaining Arsenic from Arsenious Acid and Arsenic Sulphides.—C. Brame.—In forensic chemistry, for the reduction of arsenious acid, it is common to employ potassium cyanide, or lamp-black heated and mixed with potassa. These bodies have the great disadvantage of containing deliquescent matter, which, on the one hand, interferes to some extent with the reaction, and on the other hand, gives off watery vapour in sufficient quantity to fracture the red-hot test-tubes by its condensation. For forty years the author has employed baryta, which, though hydrated and in powder, does not present these inconveniences; the reaction manifes ed by the mixture of powdered arsenious acid and baryta heated to redness is instantaneous, and is not accompanied by any disengagement of moisture. The ring formed has a perfectly metallic appearance. There is formed, besides metallic arsenic, barium arseniate, which, if dissolved in nitric acid, gives a red precipitate with silver nitrate. Analogous, but less distinct, results are obtained with lime, potassa, and soda. Arsenic sulphides yield likewise arsenic with baryta, but less easily than arsenious acid. In case of orpiment there is deflagration. On causing chlorine to act upon the arsenical rings obtained in Marsh's modified apparatus, there is formed arsenic perchloride, which, by the action of air and moisture, is transformed into hydrochloric and arsenic acids.

Action of Dry Carbonic Acid upon Quicklime.—F. M. Raoult.—A fragment of dry quicklime, heated to about the melting-point of glass and exposed to a current of pure, dry carbonic acid, absorbs the gas with great energy, becoming incandescent. It is necessary that the lime should not contain more than from 2 to 3 per cent of foreign matter, and that it should not have been burnt at too high a temperature. The compound produced is a bibasic calcium carbonate. It is practically impossible to produce the neutral carbonate by direct synthesis. If lime has been burnt at temperatures exceeding 1100° it absorbs carbonic acid very slowly, and appears as if its molecules had been condensed and in some sort polymerised by the heat.

The Losses of Nitrous Compounds in the Manufacture of Sulphuric Acid, and a Means for their Decrease.—MM. Lasne and Benker.—Inserted at length.

Resistance of Tempered Glass to Flexion.—M. de la Bastie.—It appears that the elasticity of tempered glass is more than doubled. Plain glass tempered has a resistance about two and a half times greater than ordinary double glass. "Half-double" glass tempered has about 3·1 times more resisting power than ordinary double glass.

Cholesten.—W. E. Walitzky.—This compound, $C_{26}H_{42}$, is a white amorphous powder, almost insoluble in alcohol, but soluble in ether. It resembles *c.* cholesterin in its physical and chemical properties.

The Preparation of Crotonic Aldehyd.—M. Newbury.—The author by the process of M. Wurtz has obtained from 100 to 125 grms. crotonic aldehyd from 1 kilo. of paraldehyd.

Moniteur Scientifique, Quesneville.
September, 1880.

Use of the Salts of Vanadium in the Arts.—This paper, a compilation by the Swedish Vanadium Company, Aktie Bolaget Urda, of Stockholm, contains some important information on aniline-blacks. For an aniline-black which does not turn green, which requires no subsequent treatment liable to degrade the black and soil the whites, the following process is recommended:—

Water	5500 grms.
White starch	1250 „
Dark calcined do.	420 „
Boil, and when cooled down to 50°, add—	
Aniline oil (of d'Andiran and Wegelin, Mulhouse)	800 „
Hydrochloric acid, 21° B.	800 „
When cold add further—	
Sodium chlorate	420 „
Boiling water	500 „
And, at the moment of using, add—	
Vanadic solution, 10 grms. per litre	200 „

The goods are aged for two days, passed through bichromate solution at 5 grms. per litre at 70°, and soaped. Instead of adding to the aniline oil the above-mentioned proportion of hydrochloric acid it is well to neutralise the aniline by adding the acid gradually, till a few drops of the liquid introduced into a very dilute solution of Paris violet (1 grm. per litre) turns the violet colour to a greenish blue. The "vanadic solution" above mentioned is obtained by dissolving, *e.g.*, 10 grms. ammonium vanadiate in 40 grms. hydrochloric acid, slightly diluted, in a porcelain capsule at a gentle heat, and adding glycerine in small doses, keeping the liquid at a boil till its colour passes to a deep green and all the particles are dissolved. The whole is then made up with water to 1 litre and preserved in a stoppered bottle.

Justus Liebig's Annalen der Chemie,
Heft 1 and 2, 1880.

The Chemical Constitution of Organic Bodies with Reference to their Density and their Power of Refracting Light (Second part).—J. W. Brühl.—The author concludes that the atomic refraction of chlorine, bromine, and iodine is unchangeable, the polyvalent elements only possessing a variable atomic refraction. The influence of the double combination between oxygen and carbon is perfectly distinct from that resulting from the double combination between two carbon atoms. The specific property of refraction of different bodies, and their power of dispersing light, is greatly increased by the double attraction of the carbon atoms, whilst the double combination between carbon and oxygen has very little influence in this respect.

Communications from the Chemical Laboratory at Greifswald.—These communications consist of a paper by H. v. Reiche on Two Azo-disulpho-benzolic Acids, and a memoir by A. T. Neale on Two Azo-sulpho-toluolic Acids.

Dichlor-acrylic Acid.—O. Wallach.—The dichlor-acrylic acid from chloralide is perfectly distinct from that obtained from muco-chloric acid by Bennett and Hill.

Certain Decompositions of Mesoxalic Acid.—Dr. Carl Böttinger.—The decompositions here examined are those produced by the action of water with the aid of heat and by the action of sulphuretted hydrogen.

The Alkaloids of Dita Bark.—O. Hesse.—A minute description of ditamine, echitamine, oxy-echitamine, and echitenine.

Researches from the Chemical Institute of the University of Strassburg.—These communications comprise a treatise by Gustav. Schultz on the constitution of Phenanthrene; and a memoir by H. Schmidt and G. Schultz on Diphenyl-benzols.

The Bark of Alstonia Spectabilis.—O. Hesse.—This bark contains six times as much echitammonium hydroxide as dita bark, and as the effects of this compound upon the animal system resemble those of curare, the bark must be considered poisonous.

Certain Ultramarine Compounds (Third Part).—Karl Heumann.—Pure blue sodium ultramarine if heated with silver solution passes into light yellow silver ultramarine. The composition of the latter was almost identical, though ultramarine from different manufactories was used as a material. The silicate contained in silver ultramarine contains twice as many atoms of silver as the apposited silver sulphide, and on boiling with sodium chloride only the silver in the silicate is replaced by sodium. On fusion with alkaline haloids blue ultramarine free from silver is obtained; a green potassium- and a red lithium-ultramarine can also be obtained. The "blueing" process depends on a conversion of the mono-sulphide combined with the silicate into disulphide by nascent sulphur.

An Aceton Base Containing Sulphur.—W. Heintz.—Not suitable for abstraction.

Heft 3, 1880.

The Ethyl Series of Silicium.—C. Friedel and A. Ladenburg.—The authors, after referring to the opinions of Dumas, Wœhler, and others, on the analogy between silicon and carbon, ask if it is possible to produce compounds in which several atoms of silicon are combined with each other? They then proceed to a description of silicon hexa-iodide, silicon di-iodide, oxalo-silicic acid, silicon hexethyl, and silicon hexa-bromide and hexachloride.

The Chemical Constitution of Organic Bodies with Reference to their Density and their Power of Refracting Light (Third Part).—J. W. Bruhl.—The principal conclusions reached by the author are that molecular refractions permit merely the classification of the possible cases of isomerism, in as far as these depend in different manners upon the claims of disposible atomicity; but that closer isomerism, which depends on different arrangement of the atoms, cannot be ascertained by molecular refraction. The indices of refraction of the primary and the normal compounds are greater than those of the secondary and the iso-compounds, and in case of all colours the difference of the indices of two isomers is about equal, and approximately the same as between the coefficients of refraction. The density of the normal compounds is always the greatest. From the circumstance that the specific refringent power of isomeric fatty bodies is equal, whilst their densities and their indices of refraction are different, it follows that the refraction-indices of these substances must rise and fall with the density, *i.e.*, the refraction-indices less unity, or the "refringent powers" are proportional to the specific gravities of these isomers. Normal propan-derivatives, though unsymmetric, have a greater specific gravity than the symmetric iso-propyl derivatives, and this rule is based on the general phenomenon that among isomeric bodies that one possesses the greatest density which consists of an unbroken series of hydrocarbon residues, and whose carbon skeleton extends in an uninterrupted straight line. It may be considered a rule that in isomeric bodies the boiling-points, densities, and indices of refraction behave in an analogous manner, these physical constants becoming smaller the more the structure of the molecules deviates from one direction, and is divided into branches, and that the constants of that isomer are the greatest which forms an unbroken chain of hydrocarbon residues. Among isomeric bodies an equal number of molecules requires so much the longer time to traverse a capillary tube the higher are its boiling-point, its density, and its index of refraction. The molecular volume of isomeric compounds is the greater the shorter the molecule, *i.e.*, the more their structure approaches to a straight line.

Contributions to the History of the Orcines: Betorcinol and some of its Derivatives.—J. Stenhouse and C. E. Groves.—The authors describe the preparation of betorcinol, its tetra-chlor-, brom-, dibrom-, iod-, and nitroso- derivatives, and its acid, the barbatic acid, $C_{19}H_{20}O_7$.

The Phosphorescence of Organic and Organised Bodies.—Bronislaus Radziszewski.—In this interesting and comprehensive paper the author shows that phosphorescence is merely a special case of ordinary combustion.

On Tri-aceton-diamine.—W. Heintz.—An account of the acid and neutral oxalates, and the hydrochlorate of this base.

The Decomposition of Brom-ethyl-acrylic Acid by Caustic Potassa.—A. R. Friedrich.—The author describes the preparation of this acid and examines the accompanying by-products. He states that at high temperatures it is decomposed by potassa, yielding a trace of an acid of high molecular weight, sparingly soluble in water, and perhaps isomeric with dihydrophthalic acid, potassium bromide, potassium carbonate, allylene, marsh-gas, and acetic acid.

The Chemical Constitution of Organic Bodies in Relation to their Density and their Power of Refracting Light.—J. W. Bruhl.—A sequel to the paper noticed above.

Les Mondes, Revue Hebdomadaire des Sciences.
No. 6, October 21, 1881.

Physiological Effects of Glycerin.—MM. Beaumetz and Audigé.—Chemically pure glycerin if injected under the skin of dogs proves fatal within twenty-four hours if the dose reaches 8 to 10 grms. per kilo. of the weight of the animal. The symptoms are comparable to those of acute alcoholism.

A Thermo-electric Apparatus for the Discovery of Local Temperatures.—Dr. P. Redard.—This paper cannot be intelligibly abstracted without the accompanying illustration.

No. 7, October 28, 1880.

On Diffusion.—Capt.—A. d'Obermayer.—It would be expected according to the kinetic theory of gases that the exponent indicating the dependence of the coefficient of diffusion on the absolute temperature would exceed that of the coefficient of the interior friction by unity. According to experiments upon the gases hitherto reputed permanent, the latter exponent has been found approximately = $\frac{3}{4}$, and for the coercible gases = 1.

Imperial Academy of Sciences of Vienna.—**Volta's Fundamental Experiment.**—Prof. Fr. Exner.—Experiment shows that on the surface which separates two heterogeneous metals no electro-motor force, in the meaning of Volta's theory, enters into activity, but that all the metals in mutual connection are on the same potential level. A new theory of Volta's fundamental experiment admits as the source of the electric excitement, not the electro-motor force of contact, but rather the existence of layers of oxide on the surface of the metals. This view suffices for the explanation of all the phenomena observed by Volta.

Electric Rings.—Prof. E. Reitlinger.—Not suitable for abstraction.

Roasted Coffee.—O. Bernheimer.—By roasting coffee there are obtained first the fatty acids present in the raw beans, then caffeine, and lastly a new substance, the vehicle of the aroma of coffee. The quantity of the volatile caffeine is to that of the unroasted coffee as 0·20 to

100. The new substance (oil of coffee) is a heavy oil which turns yellow on contact with the air. Its composition is $C_8H_{10}O_2$.

Pyrogallic and Gallic Acids.—Prof. Senhofer and Dr. C. Brunner.—Pyrogallic acid if treated with ammonium carbonate yields two acids, $C_8H_6O_7$ and $C_7H_6O_5$. The former of these acids is also obtained by the treatment of gallic acid.

The Refractive Power of Molecules.—J. V Janovsky.—Isomeric bodies have not an equal index of refraction. The formula empirically established by Landolt. Gladstone, and Dale for calculating the molecular refractive power gives an accurate result only in cases where the optical relations of the different series are known.

No. 8, November 4, 1880.

Detection of the Origin of Wools.—M. Levoiturier, of Elbeuf, has succeeded in identifying wools of different growth by means of the insects found in the bales.

Prof. Klebs, of Prague, has discovered peculiar microbia in the remains of patients who have died of typhoid fever. They do not occur in the bodies of persons who have been carried off by other diseases.

No. 9, November 11, 1880.

It is said that certain paper collars and cuffs, which are extensively made in America, have proved poisonous. According to the *Monde de la Science* they contain a notable proportion of arsenic.

Curious Physical Phenomenon.—Dr. Grassi forms an apparatus of three concentric vessels, leaving between them annular spaces of about 2 centimetres. The outer space is filled with oil, and the inner with water. The oil is heated by a gas furnace to above 100°, when the water begins to boil. Oil heated to 150° is then introduced into the central vessel, and falls rapidly to a temperature close upon 100°. He finds that this central oil cools more quickly the greater is the heat of the outer ring of oil.

No. 10, November 18, 1880.

Prof. Chevreul has just concluded his fiftieth annual course of lectures on chemistry applied to the study of organic beings.

An international exhibition connected with electricity will open in Paris, August 1, 1881, and will close on the 15th of November following.

A Novel Actinic Phenomenon.—Dr. Phipson.—The author describes a zinc-white of a dazzling purity obtained by precipitating a solution of zinc sulphate by means of barium sulphide, submitting the precipitate to strong pressure, and igniting it with limited access of air. If any barium sulphide escapes oxidation the white compound, on exposure to the sun, begins to darken, and in about twenty minutes becomes of a deep slate colour. If removed into a dark place it gradually loses colour, and in about five or six hours it becomes again snow-white. This experiment may be repeated with the same specimen as often as desired. Further, this change of colour does not take place under a slip of common glass, whether thick or thin; at most the compound takes a slight yellowish brown colour on exposure to the sun for two hours. The sample on analysis was not found to contain silver or any other substance known as actinic.

Double Refraction.—Prof. V. de Lang.—The theory of Cauchy, which has become of such importance for the interpretation of the phenomena of dispersion does not suffice to explain the laws of refraction as now known. The theory requires modification to be brought into harmony with the results of experiment.

Silver Bromide.—The action of light upon this substance varies according as the bromide is in the state of emulsion in an indifferent medium, like collodion, or in an organic substance readily oxidisable, like gelatine. Temperature, moisture, and mechanical pressure do not appear to have any influence.

Aldehyd Resin.—Dr. G. L. Ciamician.—On submitting this resin to the action of zinc-powder there is obtained a mixture of hydrocarbons, composed of ethyl-benzol, of meta- and para-ethyl-toluide, and of methyl-naphthalide.

Idryle.—Dr. G. Goldschmiedt.—This hydrocarbon combines with chlorine and with two proportions of bromine. Disulpho-idryle, on treatment with potassium, yields a non-crystalline cyanide.

Phenols and Aromatic Acids.—C. Senhofer and C. Brunnet.—On treating orcine with ammonium carbonate there is obtained an acid isomeric with orsellic acid, from which it differs by its slight solubility in water and by taking a blue colour in contact with salts of iron. On dry distillation it is decomposed into orcine and carbonic acid.

NOTES AND QUERIES.

Filter-Papers.—Can any of your correspondents give the name and address of the maker of the genuine Munktell's filter-paper?—A Subscriber.

Action of Radiant Heat upon Gaseous Matter.—Reading with interest the valuable paper of Professor Tyndall, an explanation of a phenomenon I had often noticed dawned upon me. When small bulbs (about three-eighths of an inch) are blown upon thin short glass tubes of small diameter, and the bulb after cooling re-introduced into the flame (Bunsen or blast burner), a loud musical note is *occasionally* produced, which ceases when the glass softens. May not the air-gas flame represent intermitting beams of radiant (or direct) heat, which, by communicating their rapid motion to the *aqueous vapour* sometimes present in the bulb, so produce a violent molecular disturbance, giving rise to sound? May not also the "hydrogen note" derive its great intensity partly to the presence of water vapour?—W. Bettel, Worcester.

Tin Sulphocyanide.—In the Chemical News, vol. xlii., p. 331, I noticed a remark concerning the use of tin sulphocyanate in calico-printing; and, again, in vol. xliii., p. 72, you remark that a note from M. Brandt was read to the Industrial Society of Mulhouse "On the Preparation of Thermic Sulphocyanate by the Double Decomposition of Calcium Sulphocyanate and Thermic Oxalate." I have been working at the subject for some time, and as I cannot obtain a copy of the *Moniteur Scientifique* whence your extract has been taken, may I ask you if there is anything in M. Brandt's note which calls for special attention, either in the preparation of the materials or manipulation? I have found the preparation of stannic oxalate (it does not appear to be a commercial article) the most tedious part of the manufacture. Any information in regard to M. Brandt's note I will feel much indebted for.—John Mac Vine.

MEETINGS FOR THE WEEK.

Monday, 21st.—London Institution, 5.
— Medical, 8.30.
Tuesday, 22nd.—Royal Institution, 3 p.m. "The Blood," Prof. Schäfer.
— Civil Engineers, 8.
— Medical and Chirurgical, 8.30.
— Society of Arts, 8. "Languages of South Africa," Mr. Robert Cust.
— Anthropological Institute, 8. "Remarks on Arrow-poisons prepared by some Tribes of North American Indians," W. J. Hoffman, M.D. "The Gauchos of San Jorge, Central Uruguay," David Christison, M.D.
Wednesday, 23rd.—Society of Arts, 8. "River Conservancy," Mr. C. N. Cresswell,
— Geological, 8.
Thursday, 24th.—London Institution, 7.
— Royal, 4.30.
— Royal Society Club, 6.30.
— Royal Institution, 3. "Drawing Room Music," Prof. Pauer.
— Society of Arts, 8. "Deep Sea Investigation and the Apparatus used in it," Mr. Buchanan.
Friday, 25th.—Royal Institution, 8. "Excitability in Plants and Animals," Dr. J. S. Burdon-Sanderson, 9.
— Quekett, 8.
Saturday, 26th.—Royal Institution, 3. "Ancient Egypt," Mr. R. S. Poole.
— Physical, 3. "On an Integrating Machine," C. V. Boys. "On the Telegraphic Transmission of Pictures of Natural Objects," Shelford Bidwall.

THE CHEMICAL NEWS.

VOL. XLIII. No. 1109.

ON THE
VISCOSITY OF GASES AT HIGH EXHAUSTIONS.*

By WILLIAM CROOKES, F.R.S.

BY the viscosity or internal friction of a gas, is meant the resistance it offers to the gliding of one portion over another. In a paper read before the British Association in 1859, Maxwell† presented the remarkable result that on theoretical grounds the coefficient of friction, or the viscosity, should be independent of the density of the gas, although at the same time he states that the only experiments he had met with on the subject did not seem to confirm his views.

An elaborate series of experiments were undertaken by Maxwell to test so remarkable a consequence of a mathematical theory; and in 1866, in the Bakerian lecture for that year,‡ he published the results under the title of "The Viscosity or Internal Friction of Air and other Gases." He found the coefficient of friction in air to be practically constant for pressures between 30 ins. and 0·5 inch; in fact numbers calculated on the hypothesis that the viscosity was independent of the density agreed very well with the observed values.

The apparatus used by Maxwell was not of a character to admit of experiments with much lower pressures than 0·5 inch.

Maxwell's theory, that the viscosity of a gas is independent of the density, presupposes that the mean length of path of the molecules between their collisions is very small compared with the dimensions of the apparatus; but inasmuch as the mean length of path increases directly with the expansion, whilst the distance between the molecules only increases with the cube root of the expansion, it is not difficult with the Sprengel pump to produce an exhaustion in which the mean free path is measured by inches, and even feet, and at exhaustions of this degree it is probable that Maxwell's law would not hold.

The experiments recorded in this paper were commenced early in 1876, and have been continued to the present time. In November, 1876, the author gave a note to the Royal Society on some preliminary results. Several different forms of apparatus have since been used one after the other, with improvements and complexities suggested by experience or rendered possible by the extra skill acquired in manipulation. The earlier observations are now of little value, but the time spent in their prosecution was not thrown away, as out of those experiments has grown the very complicated apparatus now finally adopted.

The Viscosity Torsion Apparatus with which all the experiments here given have been performed, is a very complicated instrument, and cannot be well understood without the accompanying drawings. It consists essentially of a glass bulb, blown with a point at the lower end, and sealed on to a long narrow glass tube. In the bulb is suspended a plate of mica, by means of a fine fibre of glass, 26 inches long, which is sealed to the top of the glass tube, and hangs vertically along its axis. The plate of mica is ignited and lamp-blacked over one-half. The tube is pointed at the upper end, the upper and lower points are 46 inches apart, and are accurately in the prolongation of the axis of the tube. Sockets are firmly fixed to a solid support, so that when the tube and bulb are clamped between them they are only able to move around the vertical axis. The glass fibre being only connected with the tube at the top, rotating the tube on its axis communicates torsion to the fibre, and sets the mica plate swinging on the same axis without giving it any pendulous movement. The diameter of the fibre is about 0·001 inch. The viscosity apparatus is connected to the pump by a flexible glass spiral, so as to allow the apparatus to rotate on the pivots and at the same time to be connected to the pump altogether with sealed glass joints. An arm working between metal stops, limits the rotation to the small angle only which is necessary.

The torsional movement given to the mica plate, by the light of the candle shining on it or by the rotation of the bulb and tube on its axis by the movement of the arm between the stops, is measured by a beam of light from a lamp, reflected from a mirror to a graduated scale.

The pump employed has already been described. The measuring apparatus is similar to that described by Prof. McLeod* before the Physical Society, June 13th, 1874. As it contains several improvements shown by experience to be necessary when working at very high vacua, a detailed description is given in the paper.

When taking an observation the arm is moved over to the stop, and in a few seconds allowed to return to its original position by the action of a spring. This movement rotates the viscosity apparatus through a small angle, and sets the mica plate vibrating, the reflected line of light traversing from one side of the scale to the other in arcs of diminishing amplitude till it finally settles down once more at *zero*.

The observer watching the moving index of light records the scale number reached at the extremity of each arc. The numbers being alternately on one and the other side of zero are added two by two together, to get the value of each oscillation. The logarithms of these values are then found, and their differences taken; the mean of these differences is the logarithmic decrement per swing of the arc of oscillation. For the sake of brevity this is called the log dec.

A very large number of experiments have been made on the viscosity of air and other gases. Observations have been taken at as high an exhaustion as 0·02 M, but at these high points they are not sufficiently concordant to be trustworthy. The pump will exhaust to this point without difficulty if a few precautions are taken, but at this low pressure the means of measuring fail in accuracy.

The precautions which experience shows to be necessary when exhausting to the highest points are fully described in the paper.

Viscosity of Air.

The mean of a very large number of closely concordant results gives as the log decrement for air for the special apparatus employed, at a pressure of 760 millims. of mercury and a temperature of 15° C., the number 0·1124. According to Maxwell the viscosity should remain constant until the rarefaction becomes so great that we are no longer at liberty to consider the mean free path of the molecules as practically insignificant in comparison with the dimensions of the vessel.

The author's observations show that this theoretical result of Maxwell's is at least approximately and may be accurately true in air up to such exhaustions as are above referred to; and that at higher exhaustions the viscosity falls off, as it might be expected to do according to theory.

The results are embodied in a table and diagrams.

The first half of the table gives the viscosity of air, in so far as it is represented by the log dec., at pressures intermediate between 760 millims. and 0·76 millim. (1000 millionths of an atmosphere). In order to avoid the inconvenience of frequent reference to small

---

[*] Abstract of a Paper read before the Royal Society, February 17, 1881.

[†] Phil. Mag., 4th Ser., vol. xix., p. 31.

[‡] Phil. Trans., 1866, Part 1, p. 249.

[*] Philosophical Magazine, vol. xlviii., p. 110, August, 1874.

fractions of a millimetre, the millionth of an atmosphere* (=M) is now taken as the unit instead of the millimetre. The second half of the table is therefore given in millionths, going up to an exhaustion of 0·02 millionth of an atmosphere.

Starting from the log dec. 0·1124 at 760 millims., the viscosity diminishes very regularly but at a somewhat decreasing rate. Between 50 millims. and 3 millims. the direction is almost vertical, and a great change in the uniformity of the viscosity curve commences at a pressure of about 3 millims. At this point the previous approximation to, or coincidence with, Maxwell's law begins to fail, and further pumping considerably reduces the log decrement.

From 1000 M the diminution of viscosity is very slight until the exhaustion reaches about 250 M; after that it gets less with increasing rapidity, and falls away quickly after 35 M is reached.

The curves of increasing mean free path and diminishing viscosity closely agree. This agreement is more than a mere coincidence, and is likely to throw much light on the cause of viscosity of gases.

In the table is also given the measurements of the repulsion exerted on the blackened end of the mica plate by a candle-flame placed 500 millims. off. The repulsion due to radiation commences just at about the same degree of exhaustion where the viscosity begins to decline rapidly, and it principally comes in at the exhaustions above 1000 M.

The close agreement between the loss of viscosity and the increased action of radiation is very striking up to the 35 millionth, when the repulsion curve turns round and falls away as rapidly as the viscosity.

Experiments are next described on the resistance of air to the passage of an induction spark.

Since the publication of the author's researches on the phenomena presented by the passage of the induction discharge through high vacua, the present results—which, although never published, precede by a year or two those just mentioned—have lost much of their interest.

The phenomena at the very high exhaustion of 0·02 M may be of interest. With a coil giving a spark 85 millims long, no discharge whatever passes. On increasing the battery power till the striking distance in air was 100 millims. the spark occasionally passed through as an intermittent flash, bringing out faint green phosphorescence on the glass round the end of the — pole.

On one occasion the author obtained a much higher exhaustion than 0·02 M. It could not be measured, but from the repulsion by radiation and the low log dec. it was probably about 0·01 M. The terminals of the vacuum tube and wires leading to them were well insulated, and the full power of a coil giving a 20-inch spark was put on to it. At first nothing was to be seen. Then a brilliant green light flashed through the tube, getting more and more frequent. Suddenly a spark passed from a wire to the glass tube, and broke it, terminating the experiment.

Since these experiments vacua have frequently been got as high, and even higher, but the author has never seen one that would long resist the 20-inch spark from his large coil.

Viscosity of Oxygen.

The series of experiments with air show a complete history of its behaviour between very wide limits of pressure. It became interesting to see how the two components of air, oxygen and nitrogen, would behave under similar circumstances. Experiments were therefore instituted exactly as in the case of dry air, but with the apparatus filled with pure oxygen.

The results are given in the form of tables and plotted as curves on diagrams.

The figures show a great similarity to the air curve. Like it the log dec. sinks somewhat rapidly between pressures from 760 millims to about 75 millims. It then remains almost steady, not varying much till a pressure of 16 millims. is reached. Here, however, it turns in the opposite direction, and increases up to 1·5 millim. It then diminishes again, and at higher exhaustions it rapidly sinks. This increase of viscosity at pressures of a few millimetres has been observed in other gases, but only to so small an extent as to be scarcely beyond the limits of experimental error. In the case of oxygen, however, the increase is too great to be entirely attributable to this cause.

Oxygen has more viscosity than any gas yet examined. The viscosity of air at 760 millims. being 0·1124, the proportion between that of air and oxygen, according to these results, is 1·1185.

This proportion of 1·1185 holds good (allowing for experimental errors) up to a pressure of about 20 millims. Beween that point and 1 millim. variations occur, which have not been traced to any assignable cause: they seem large to be put down to "experimental errors." The discrepancies disappear again at an exhaustion of about 1 millim., and from that point to the highest hitherto reached the proportion of 1·1185 is fairly well maintained.

Viscosity of Nitrogen.

The proportion between the viscosities of nitrogen and air at a pressure of 760 millims. is, according to these experiments, 0·9715.

A comparison of the air curves with those given by oxygen and nitrogen gives some interesting results. The composition of the atmosphere is, by bulk,

Oxygen	20·8
Nitrogen	79·2
	100·0

The viscosity of the two gases is almost exactly in the same proportion: thus at 760 millims—

$$\frac{20·8\ \textit{vis.}\ \mathrm{O}+79·2\ \textit{vis.}\ \mathrm{N}}{100}=\textit{vis.}\ \text{air},$$

$$\frac{20·8\ (0\ 1257)\ +79·2\ (0·1092)}{100}=\quad ,,$$

$$\frac{2·61456+8·64072}{100}=0·11255,$$

a result closely coinciding with 0·1124, the experimental result for air. Up to an exhaustion of about 30 M the same proportion between the viscosities of air, oxygen, and nitrogen is preserved with but little variation. From that point divergence occurs between the individual curves of the three gases.

Observations on the spectrum of nitrogen are next given.

The curve of Repulsion exerted by Radiation is plotted on the Diagrams. It is much lower than in oxygen or air, and sinks rapidly fter the maximum is passed.

Viscosity of Carbonic Anhydride.

The curves of this gas are given in Diagrams plotted from the observations. At first the curve seems to follow the same direction as the air curve. But at a pressure of about 620 millims. it slopes more rapidly till the pressure is reduced to about 50 millims., when the curve again takes the direction of the air curve. The total diminution between 760 millims. and 1 millim. is nearly double that of air.

The proportion between the viscosity of carbonic anhydride and air at 760 millims. is 0·9208.

Viscosity of Carbonic Oxide.

The results with this gas are remarkable as showing an almost complete identity with those of nitrogen both in position and shape. The viscosity at 760 millims. is in each case 0·1092.

Like that of nitrogen, the curve of carbonic oxide is seen to be vertical,—*i.e.*, assuming the curve to represent

---

* 1 M=0·00076 millim.; 1315·789 M=1 millim.

the viscosity, the gas obeys Maxwell's law, at pressures between 90 millims. and 3 millims. The straight portion in nitrogen is at a little higher pressure,—between 100 millims. and 6 millims.

The curve of Repulsion resulting from Radiation is lower in carbonic oxide than in any other gas examined, and, unlike the other gases, there is no sudden rise to a maximum at about 40 M. At lower exhaustions the curve is, however, higher than it is in nitrogen.

Viscosity of Hydrogen.

It has been found that hydrogen has much less viscosity than any other gas; the fact of the log dec. not decreasing by additional attempts at purification is the test of its being free from admixture. This method of ascertaining the purity of the gas, by the uniformity of its viscosity coefficient at 760 millims., is more accurate than collecting samples and analysing them eudiometrically.

Several series of observations in hydrogen have been taken. For a long time it was considered that hydrogen, like other gases, showed the same slight departure from Maxwell's law of viscosity being independent of density that appeared to be indicated with other gases; for the log dec. persistently diminished as the exhaustion increased, even at such moderate pressures as could be measured by the barometer gauge. Had it not been that the rate of decrease was not uniform in the different series of observations, it might have been considered that this variation from Maxwell's law was due to some inherent property of all gases. After working at the subject for more than a year, it was discovered that the discrepancy arose from a trace of water obstinately held by the hydrogen. Since discovering this property, extra precautions (already described at the commencement of this paper) have been taken to dry all gases before entering the apparatus.

The remarkable character of hydrogen is the uniformity of resistance which it presents. It obeys Maxwell's law almost absolutely up to an exhaustion of about 700 M, and then it commences to break down. Up to this point the line of viscosity is almost perfectly vertical. It then commences to curve over, and when the mean free path assumes proportions comparable with the dimensions of the bulb, and approaches infinity, the viscosity curve in like manner draws near the zero line.

The repulsive force of radiation is higher in hydrogen than in any other gas. It commences at as low an exhaustion as 14 millims., but does not increase to any great extent till an exhaustion of 200 M is attained; it then rises rapidly to a maximum at between 40 and 60 M, after which it falls away to zero. The maximum repulsion exerted by radiation in hydrogen is to that in air as 70 to 42·6. This fact is now utilised in the construction of Radiometers and similar instruments when great sensitiveness is required.

Taking the viscosity of air at 760 millims. as 0·1124, and hydrogen as 0·0499, the proportion between them is 0·4439.

The Spectrum of Hydrogen.

The red line ($\lambda = 6562$), the green line ($\lambda = 4861$), and the blue line ($\lambda = 4340$) are seen at their brightest at a pressure of about 3 millims., and after that exhaustion they begin to diminish in intensity. As exhaustion proceeds a variation in visibility of the three lines is observed. Thus at 36 millims. the red line is seen brightly, the green faintly, whilst the blue line cannot be detected. At 15 millims. the blue line is seen, and the three keep visible till an exhaustion of 418 M is reached, when the blue line becomes difficult to see. At 38 M only the red and green lines are visible, the red being very faint. It is seen with increasing difficulty up to an exhaustion of 2 M, when it can be seen no longer. The green line now remains visible up to an exhaustion of 0·37 M, beyond which it has not been seen.

It is worthy of remark that although, when working with pure hydrogen the green line is always the last to go, it is not the first to appear when hydrogen is present as an impurity in other gases. Thus when working with carbonic anhydride insufficiently purified, the red hydrogen line is often seen, but never the green or the blue line.

Influence of Aqueous Vapour on the Viscosity of Air.

In the foregoing experiments many discrepancies were traced to the presence of moisture in the gas. The influence of aqueous vapour does not appear to be great when present in moderate amount in gas of normal density, but at high exhaustions it introduces errors which interfere with the uniformity of the results. A series of experiments were accordingly undertaken to trace the special action of aqueous vapour when mixed with air.

Up to a pressure of about 350 millims. the presence of aqueous vapour has little or no influence on the viscosity of air. The two curves are in fact superimposed. At this point, however, divergence commences, and the curve rapidly bends over, the viscosity falling from 0·0903 to 0·0500 between 50 and 7 millims. pressure. Here it joins the hydrogen curve, and between 7 millims. and 1 millim. they appear to be identical.

These results are partly to be explained by the peculiar action of water vapour in the apparatus. At the normal pressure the amount of aqueous vapour present in the air, supposing it to be saturated, is only about 13 parts in a million, and the identity of the log dec. with that of dry air shows that this small quantity of water has no appreciable action on the viscosity. When the pump is set to work the air is gradually removed, whilst the aqueous vapour is kept supplied from the reservoir of liquid. As the exhaustion approaches the tension of aqueous vapour, evaporation goes on at a greater rate, and the vapour displaces the air with increasing rapidity; until, after the pressure of 12·7 millims. is passed, the aqueous vapour acts as a gas, and, being constantly supplied from the reservoir of water (as long as it lasts), washes out all the air from the apparatus, the log dec. rapidly sinking to that of pure water gas.

This explanation requires that the viscosity of pure aqueous vapour should be the same as that of hydrogen, at all events between 7 millims. and 1 millim. pressure. The facts can, however, be explained in another way. During the action of the Sprengel pump sufficient electricity is sometimes generated to render the fall tubes luminous in the dark. It is conceivable that under such electrical influence the falling mercury may be able to decompose aqueous vapour at these high exhaustions, with formation of oxide of mercury and liberation of hydrogen. Of these two theories the latter appears to be the more probable.

The presence of water vapour shows itself likewise in the very slight amount of repulsion produced by radiation. Repulsion commences in air at a pressure of 12 millims., whilst at a higher exhaustion the maximum effect rises to over 40 divisions. Here, however, repulsion does not begin till the exhaustion is higher than the barometer gauge will indicate, whilst the maximum action after long-continued pumping is only 9 divisions.

Viscosity of Kerosoline Vapour.

The rapid diminution of viscosity in the last experiment after reaching the pressure of 400 millims. is probably due to the aqueous vapour in the air being near its liquefying point. It was thought advisable to test this hypothesis by employing a somewhat less easily condensible vapour, which could be introduced into the apparatus without any admixture of air. An experiment was accordingly tried with a very volatile hydrocarbon, commercially known as Kerosoline, boiling at a little above the ordinary temperature. The vapour of this body was introduced into the well-exhausted apparatus, when the gauge at once sank 82·5 millims. After the usual precautions to eliminate air a series of observations were taken.

The loss of viscosity is more rapid than with any other gas examined except aqueous vapour. Conversely a very great increase of viscosity occurs on increasing the pressure from 8 to 82·5 millims. The explanation of this is that the vapour of kerosoline is very near its liquefying point, and therefore very far from the state of a "perfect" gas.

The negative bend in the curve at about 10 millims. pressure, already noticed with other gases, is strongly marked with this hydrocarbon vapour.

Discussion of Results.

When discussing the viscosity results obtained with the different gases experimented with, the author gives the following approximate comparison of viscosities, such as is afforded by a comparison of the log decs. of each gas and that of air, comparing the ratio with that obtained by Graham, Kundt and Warburg, and Maxwell.

	Graham.	Kundt & Warburg.	Maxwell.	Crookes.
Air	1·0000	1·0000	1·0000	1·0000
Oxygen	1·1099	—	—	1·1185
Nitrogen	0·971	—	—	0·9715
Carbonic oxide ...	0·971	—	—	0·9715
Carbonic anhydride	0·807	0·806	0·859	0·9208
Hydrogen	0·4855	0·488	0·5156	0·4439

Graham's numbers are the theoretical results deduced from his experiments on transpiration of gases. They are, he says,[*] the numbers to which the transpiration times of the gases approximate and in which they have their limit. Graham concludes that the "times of oxygen, nitrogen, carbonic oxide, and air are directly as their densities, or equal *weights* of these gases pass in equal times. Hydrogen passes in half the time of nitrogen, or twice as rapidly for equal volumes. The result for carbonic acid appears at first anomalous. It is that the transpiration time of this gas is inversely proportional to its density when compared with oxygen."

The proportion between air and oxygen, nitrogen, or carbonic oxide is not very different at any degree of exhaustion to that which it is at 760 millims. Carbonic anhydride, however, is different; the proportion between it and air holds good between 760 and 650 millims. Then it gets lower and lower as the pressure sinks, until 50 or 55 millims. is reached, when the proportion between it and air again becomes constant.

Hydrogen, however, is entirely different to the other gases; its log dec. remains the same to a very high exhaustion, and, that of other gases sinking, it is evident that the proportion between this gas and any other is different for each pressure.

It must not be forgotten that the pressure of 760 millims. is not one of the constants of Nature, but is a purely arbitrary one, selected for our own convenience when working near the level of the sea. In the diagrams accompanying the paper the author has started from this pressure of 760 millims., and has given the log. dec. curves which approximately represent the viscosities through a wide range of exhaustion. But the curves might also be continued, working downwards instead of upwards. From the shape and direction in which they cut the 760 line it is reasonable to infer their further progress downwards, and we may assume that an easily liquefiable gas will show a more rapid increase in viscosity than one which is difficult to liquefy by pressure. For instance, hydrogen, the least condensible of all gases, shows no tendency to increase in log dec. by pressure. Oxygen and nitrogen, which are only a little less difficult to condense than hydrogen, show a slight increase in log dec. Carbonic anhydride, which liquefies at a pressure of 56 atmospheres at 15° C., increases so rapidly in log dec. that at this pressure it would have a log dec. of about 1·3, representing an amount of resistance to motion that it is difficult to conceive anything of the nature of gas being capable of exerting.

Kerosoline vapour is rendered liquid by pressure much more readily than carbonic anhydride. Its curve shows a great increase in density for a very slight access of pressure.

Again, aqueous vapour is condensible to the liquid form with the greatest readiness; and the almost horizontal direction of the curve representing aqueous vapour mixed with air carries out the hypothesis.

It follows, then, that Maxwell's law holds good for perfect gases. The disturbing influence spoken of in the commencement of this paper as occasioning a variation from Maxwell's law, is the tendency to liquefaction, which prevents us from speaking of any gas as "perfect," and which hinders it from obeying Boyle and Mariotte's law. The nearer a gas obeys this law the more closely does it conform to Maxwell's law.

Maxwell's law was discovered as the consequence of a mathematical theory. It presupposes the existence of gas in a "perfect" state—a state practically unknown to physicists, although hydrogen gas very nearly approaches that state. An ordinary gas may be said to be bounded, as regards its physical state, on the one side by the sub-gaseous or liquid condition, and on the other side by the ultra-gaseous condition. A gas assumes the former state when condensed by pressure or cold, and it changes to the latter state when highly rarefied. Before actually assuming either of these states there is a kind of foreshadowing of change, with partial loss of gaseity. When the molecules, by pressure or cold, are made to approach each other more closely, they begin to enter the sphere of each other's attraction, and therefore the amount of pressure or cold necessary to produce a certain density is less than the theoretical amount by the internal attraction exerted on each other by the molecules. The nearer the gas approaches the point of liquefaction the greater is the attraction of one molecule to another, and the amount of pressure required to produce any given density will be proportionally less than that theoretically required by a "perfect" gas.

The Ultra-gaseous State of Matter.

After some theoretical considerations respecting the viscosity of gases the author concludes with the detailed statement of his theory of the existence of an ultra-gaseous state of matter.

A consideration of the curves of the gases, especially hydrogen, which are given in the paper, will confirm the supposition that a gas, as the exhaustions become extreme, gradually loses its gaseous characteristics, and passes to an ultra-gaseous state.

An objection has been raised touching the existence of ultra-gaseous matter in highly exhausted electrical tubes, that the special phenomena of radiation and phosphorescence which the author has considered characteristic of this form of matter can be made to occur at much lower pressures than that which exhibits the maximum effects. For the sake of argument let us assume that the state of ultra gas with its associated phenomena is at the maximum at a millionth of an atmosphere. Here the mean free path is about 4 inches long, sufficient to strike across the exhausted tube. But it has been shown by many experimentalists that at exhaustions so low that the contents of the tube are certainly not in the ultra gaseous state, the phenomena of phosphorescence can be observed. This circumstance had not escaped the author's notice. In his first paper on the "Illumination of Lines of Molecular Pressure and the Trajectory of Molecules"[*] the author drew attention to the fact that a molecular ray producing green phosphorescence can be projected 102 millimetres from the negative pole when the pressure is as high as 0·324 millim., or 427 M. In this case the mean free path of the molecules is 0·23 millim.; and it is not surprising

---

[*] *Loc. cit.*, pp. 178, 179.

[*] Phil. Trans., Part 1, 1879. The Bakerian Lecture.

that with more powerful induction discharges, and with special appliances for exalting the faint action to be detected, the above-named phenomena can be produced at still higher pressures.

It must be remembered that we know nothing of the *absolute* length of the free path or the *absolute* velocity of a molecule ; these may vary almost from zero to infinity. We must limit ourselves to the *mean* free path and the *mean* velocity, and all that these experiments show is that a few molecules can travel more than a hundred times the *mean* free path, and with perhaps a corresponding increase over the *mean* velocity, before they are stopped by collisions. With weak electrical power the special phosphorogenic action of these few molecules is too faint to be noticed ; but by intensifying the discharge the action of the molecules can be so increased as to render their presence visible. It is also probable that the absolute velocity of the molecules is increased so as to make the mean velocity with which they leave the negative pole greater than that of ordinary gaseous molecules. This being the case, they will not easily be stopped or deflected by collisions, but will drive through obstacles, and so travel to a greater distance.

If this view is correct, it does not follow that gas and ultra gas can co-exist in the same vessel. All that can be legitimately inferred is, that the two states insensibly merge one into the other, so that at an intermediate point we can by appropriate means exalt either the phenomena due to gas or to ultra gas. The same thing occurs between the states of solid and liquid, and liquid and gas. Tresca's experiments on the flow of solids prove that lead and even iron, at the common temperature, possess properties which strictly appertain to liquids, whilst Andrews has shown that liquid and gas may be made to merge gradually one into the other, so that at an intermediate point the substance partakes of the properties of both states.

*Note on the Reduction of Mr. Crookes's Experiments on the Decrement of the Arc of Vibration of a Mica Plate oscillating within a Bulb containing more or less rarefied Gas.** By Professor G. G. STOKES, Sec. R.S.

THE determination of the motion of the gas within the bulb, which would theoretically lead to a determination of the coefficient of viscosity of the gas, forms a mathematical problem of hopeless difficulty. Nevertheless we are able, by attending to the condition of similarity of the motion in different cases, to compare the viscosities of the different gases for as many groups of corresponding pressures as we please. Setting aside certain minute corrections which would have vanished altogether had the moment of inertia of the vibrating body been sufficient to make the time of vibration sensibly independent of the gas, as was approximately the case, the condition of similarity is that the densities shall be as the log decrements of the arc of vibration, and the conclusion from theory is that when that condition is satisfied, then the viscosities are in the same ratio. Pressures which satisfy the condition of similarity are said to "correspond."

It was found that on omitting the high exhaustions, the experiments led to the following law :—

The ratios of the viscosities of the different gases are the same for any two groups of corresponding pressures. In other words, if the ratios of the viscosities of a set of gases are found (they are given by the ratios of the log decrements) for one set of corresponding pressures, these pressures may be changed in any given ratio without disturbing the ratios of the viscosities.

This law follows of course at once from Maxwell's law, according to which the viscosity of a gas is independent of the pressure. It does not, however, by itself alone prove Maxwell's law, and might be satisfied even were Maxwell's law not true. The constancy, however, of the log decrement, when the circumstances are such that the molar inertia of the gas may presumably be neglected, proves that at any rate when the density is not too great that law is true ; and the variability of the log decrement at the higher pressures in all but the very light gas hydrogen is in no way opposed to it, though Mr. Crookes's experiments do not enable us to test it directly, but merely establish a more general law, which embraces Maxwell's as a particular case.

The viscosities referred to air as unity which came out from Mr. Crookes's experiments were as follows :—

Oxygen	1·117
Nitrogen and carbonic oxide ..	0 970
Carbonic anhydride	0·823
Hydrogen	0·500

The viscosity of kerosoline vapour could not be accurately deduced from the experiments, as the substance i a mixture, and the vapour-density therefore unknown. Assuming the relative viscosity to be 0·0380, the vapour-density required to make the experiments fit came out 3·408 referred to air, or 49·16 referred to hydrogen.

When once the density is sufficiently small, the log decrement may be taken as a measure of the viscosity. Mr. Crookes's tables show how completely Maxwell's law breaks down at the high exhaustions, as Maxwell himself foresaw must be the case. Not only so, but if we take pressures at those high exhaustions which are in the same ratios as "corresponding" pressures, the log decrements in the different gases are by no means in the ratios of the densities.

It would appear as if the mechanical properties of a gas at ordinary pressures and up to extreme exhaustions (setting aside the minute deviations from Boyle's law, &c.), were completely defined by two constants, suppose the density at a given pressure and the coefficient of viscosity; but that specific differences come in at the high exhaustions at which the phenomena of "ultra-gas" begin to appear ; and that, to include these, an additional constant, or perhaps more than one, requires to be known.

THE DETERMINATION OF SULPHUR IN SULPHIDES AND IN COAL AND COKE.*

By THOMAS M. DROWN, M.D.,
Lafayette College, Easton, Pa.

THE use of bromine as an oxidising agent, particularly for sulphur, has become very general in analysis, replacing the stronger oxidising acids. The object of this paper is to describe briefly the experience which we have gained with this reagent in the laboratory of Lafayette College in the oxidation of metallic sulphides.

Most of the simple sulphides, as blende, pyrites, &c., when exposed to the combined action of an alkaline hydrate and bromine, and finally to hydrochloric acid, are completely and promptly dissolved. The procedure is as follows :—The very finely pulverised mineral is first treated, in a beaker, with a solution of sodium hydrate of a specific gravity of 1·25, and heated ; bromine is then cautiously added to supersaturation, and finally hydrochloric acid to acid reaction. If any of the sulphide is not taken up the same operation may be repeated. It is necessary, however, that the mineral be very finely pulverised. Instead of using the pure bromine, a saturated solution of bromine in potassium bromide may be used with equally good effect.

The process is advantageously simplified by making a saturated solution of bromine in the concentrated alkali. This is done by pouring bromine into a solution of sodium

---

* Abstract of a Paper read before the Royal Society, February 17, 1881.

* *Transactions of the American Institute of Mining Engineers.*

hydrate, of the above-given specific gravity, until no more is taken up, and then adding a little of the sodium hydrate solution until the liquid does not give off free bromine. The procedure with this solution is as follows:—The pulverised mineral is moistened with, say, 10 c.c. of the solution, and heated, then hydrochloric acid added to just acid reaction. Two more additions of the alkaline solution, in amounts of 20 c.c. each, are added at intervals of about ten minutes, each addition being followed by hydrochloric acid. The total amount of the alkaline solution (containing the bromine) used is, therefore, 50 c.c., and the amount of hydrochloric acid should not exceed that necessary to make the solution acid after each addition of the alkali. The mixture should be kept hot. After the final addition of acid, the contents of the beaker is taken to dryness and heated in an air-bath to 110° to 115° C., to render silica insoluble. The dry mass is then taken up by hydrochloric acid, and, after filtration, the sulphuric acid is precipitated by barium chloride. In a sample of copper pyrites Mr. F. E. Bachman obtained, in duplicate analyses, 34·05 and 34·12 per cent of sulphur; in zinc blende 32·97 and 33·09 per cent. In another sample of blende Mr. P. W. Shimer obtained 32·71 per cent.

This method of determining sulphur I find especially valuable in the analysis of coal. By the treatment of coal as above described results are obtained which agree very closely. The coal, as such, is not attacked, and the sulphur obtained, therefore, represents that existing in the coal as pyrites, and also as soluble sulphates. The residue left by this treatment has been subjected again to the same process, and yields no more sulphur. On combustion, however, or by complete oxidation, either by oxidising acids or by fusion, additional sulphur may be obtained, which must represent that combined organically with the coal.

The following are some of the results obtained by Mr. Shimer from bituminous coals by the bromine method. The amount usually taken for analysis was between 1 and 2 grms.:—

Bituminous Coals.	Total Sulphur by Fusion with Alkaline Carbonates and Nitrates.	Sulphur by Bromine Process.
I.	0·43	0·035
		0·035
		0·035
II	2·16	1·80
	2·17	1·81
		1·81
		1·83
		1·84
		1·85
		1·87
III.	1·17	0·710
	1·18	0·713
		0·717
IV.	1·48	1·096
	1·49	1·098
	1·50	1·100
		1·100

In comparing the bromine method with others it was found that the treatment with hydrochloric acid and potassium chlorate gave on coals with but little sulphur in the form of pyrites the same results, but on coals with much pyrites the results were decidedly lower than by the bromine method. But too few experiments were tried on this point to be decisive. The action of nitric acid and potassium chlorate depends upon the nature of the coal. Some coals are converted partly into a brown unmanageable solution, and others are oxidised completely to a clear solution. In the latter case, of course, the total sulphur could be obtained.

As was said above, the sulphur obtained by the bromine method represents both the sulphides and sulphates in the coal. The methods ordinarily given for the separate determination of calcium sulphate are faulty. Sodium carbonate readily attacks pyrites, and dilute hydrochloric acid and even water, when heated for some time in contact with pyrites, with access of air, contain notable quantities of sulphuric acid. It would seem, therefore, necessary to dissolve out the calcium sulphate by means of water with the careful exclusion of air.

The determination of the total sulphur in coal by means of fusion with alkaline carbonates and nitrates, or chlorates, I find unsatisfactory, owing, I think, to the large amount of salts in the solution in which the barium sulphate is precipitated. A much better method is to burn the coal in a platinum boat placed in a glass tube in a current of oxygen. The products of combustion may be absorbed by a solution of bromine in hydrochloric acid, or by a dilute solution of potassium permanganate. The latter, I have satisfied myself, gives equally good results with the bromine. It is absolutely necessary, in this process, as originally pointed out by Muck,[*] that the combustion-tube should be washed out with water after the completion of the combustion, since sulphuric anhydride condenses in considerable quantity in the tube beyond the boat. It is further necessary, of course, to fuse the residual ash with alkaline carbonates to determine the sulphur which has not been volatilised by the combustion.

I have in progress an interesting investigation on the effect of coking on the sulphur in coal, to determine what influence the nature of the sulphur—whether in combination with iron as pyrites or organically combined with the coal—has on its elimination in coking. These results must, however, be reserved for a future communication.

ON THE
CHEMISTRY OF SEWAGE PRECIPITATION.[†]

By Dr. WILLIAM WALLACE.

(Concluded from p. 68).

THE question whether the effluent from precipitation will putrefy and cause a nuisance after mixing with a considerable proportion of clean river water, is one which has engaged my attention, and I am glad to be able to say that the results have been satisfactory. I cannot do better than quote a few sentences from a report I recently made to the Magistrates and Council of Glasgow, and which has been published as an appendix to a report by the deputation which visited a number of English towns last summer.

Experiments were made during July and August on the oxidising power of river water on purified sewage. An average Glasgow sewage was prepared by mixing 2 parts of Portland Street (water-closet) with one part of Reid Street (non-water-closet) sewage, and this was divided into three portions, and defecated—

A. By mechanical means only.
B. By precipitation with lime.
C. By precipitation with sulphate of alumina.

In the effluent the amount of free and organic ammonia was estimated, and 12 parts of clean Clyde water added, after which each sample was divided into two, one-half being placed in an open glass bottle, and the other in a closely stoppered bottle. After the lapse of five weeks, the ammonia was again estimated, when it was found that in every case the oxidation was all but complete, and that it went on as well in closed as in open vessels. The original mixed sewage, or rather the clear portion of it, contained 6·18 grains per gallon of free and 0·233 of organic

---

[*] Fresenius, *Zeitschrift*, xiv., 16.

[†] A Paper read before the Chemical Section of the Philosophical Society of Glasgow, December 6, 1880.

or "albuminoid" ammonia; after treatment with lime the respective quantities were 5·950 and 0·056, and after sulphate of alumina, with a certain quantity of lime (Coventry process), they were 5·880 and 0·042. The following statement shows the proportions of free and organic ammonia in the mixtures of sewage and clean water at the commencement of the experiments and after five weeks :—

	Settling or Filtration.			Purification of Lime.			By Sulphate of Alumina.		
		5 Weeks in			5 Weeks in			5 Weeks in	
	Original.	Open Bottle.	Closed Bottle.	Original.	Open Bottle.	Closed Bottle.	Original.	Open Bottle.	Closed Bottle.
Free Ammonia ..	0·487	0·0024	0·0021	0·470	0·0017	0·0012	0·465	0·0011	0·0011
Organic do. ..	0·023	0·0091	0·0087	0·009	0·0056	0·0053	0·008	0·0049	0·0078
Total	0·510	0·0115	0·0108	0·479	0·0073	0·0065	0·473	0·0060	0·0089

If the proportion of free and organic or "albuminoid" ammonia be accepted as the measure of the amount of pollution, these results shew that in five weeks, at least in the cases where defecation was effected by precipitation, the whole of the added pollution in the form of sewage had disappeared, and the water had acquired a degree of purity equal to that of the Clyde above Glasgow. Even in the sewage purified by filtration, only 2 per cent of the ammonia remained unoxidised. Experiments showed that the ammonia was converted first into nitrous, and finally into nitric acid, combined in both cases, of course, with bases (lime, magnesia, soda). In the case of the filtered sewage, kept in a closed bottle, the amount of nitric acid was found to be 1·63 grs. per gallon, equal to 0·513 of ammonia. The amount of ammonia which had disappeared during the experiment was 0·499, so that it must be concluded that the oxidation had already begun before the original estimation was made. In this series of experiments the effluents obtained by precipitation were practically inodorous, and after being mixed with the Clyde water they did not at any time acquire an appreciable odour. An experiment begun in 1879, in which crude sewage was mixed with 8 times its bulk of clean water, and the mixture kept in a loosely covered vessel, showed that even in a year the impurities did not disappear, and all the time there was abundance of fungoid growth. In none of the experiments where the defecated sewage was mixed with 8 or 12 times its bulk of clean water was there any growth of sewage fungus observed.

An experiment of similar character begun on 12th August showed that, during warm weather at least, the oxidation is very rapid. Some average Glasgow sewage was defecated by lime (in the proportion of one ton per million gallons), and mixed with 12 parts of clean Clyde water, and the result was tested on 1st September, with the following results:—

	Defecated Sewage.	Mixture, 20th August.	1st Sept.
Free Ammonia	5·320	0·4220	0·0014
Albuminoid do	0·063	0·0094	0·0070
Total	5·383	0·4314	0·0084

The mixture on 1st September contained a large proportion of nitrous acid, showing that, although the ammonia had almost disappeared, the oxidation was not yet complete. Subsequent experiments during colder weather showed that the rapidity of the oxidation depends much upon temperature, the process being decidedly slower in cold than in warm weather. If, as is asserted by some authorities, and as my own observations indicate, the process depends mainly upon the presence of *bacteria*, it is easy to understand that the oxidation, or, as it may be called, nitrification, will be more rapid in warm than in cold weather.

The result of all my experiments and observations is that Glasgow sewage, properly defecated and introduced into the Clyde at a point below the City, will not, under any circumstances, give rise to a nuisance.

The question whether lime or alumina is the more effective agent for the precipitation of sewage has engaged my attention, and the results of my observations appear to indicate that, although the alumina produces a somewhat more satisfactory effluent, the advantages obtained by its use are not sufficient to compensate for the greatly increased cost of purification, which may be set down at about four times that of lime. If, however, a very cheap variety of sulphate of alumina, with some sulphate of iron, can be obtained, or if the liquor obtained by lixiviating calcined alum shale is available; if, in fact, the cost of alumina, or a mixture of alumina and oxide of iron, could be approximated to that of lime, I would have no hesitation in recommending its use in preference to lime.

Mr. Peter Spence, of the Pendleton Alum Works, near Manchester, has proposed a very ingenious system for the purification of sewage and the utilisation of one of its constituents. The sewage is first treated with lime, and the nearly-clear effluent mixed with a solution or sulphate of alumina, which throws down albuminous compounds combined with alumina, while at the same time the free lime in the effluent is neutralised. The alumina precipitate is then treated with a sufficient quantity of sulphuric acid to combine with the alumina, forming a sulphate which can be used over again, when the albuminous matter is separated in flakes, which are collected, dried, and distilled, and the ammonia produced converted into sulphate. A careful experiment with one gallon of sewage from Portland Street sewer gave 1·5 grs. of albuminous matter, retaining 0·57, or nearly one-fourth, of the whole alumina, and containing 0·078 of a grain of nitrogen, equal to 0·38 of a grain of commercial sulphate of ammonia. 30 million gallons of such sewage would, therefore, yield by this process 1629 lbs. of sulphate of ammonia, worth about £13. On the other hand, there would be required about £90 worth of sulphate of alumina, a certain portion of which would be lost at each operation, and about £30 worth of sulphuric acid, so that the sulphate of ammonia would not go far in covering the extra expense of the process as compared with a simple precipitation by lime. Besides this, extra tank accommodation to a large extent would be required to work the process, which appears to be of too complicated a character for practical sewage precipitation. It is only right to state, however, that Mr. Spence, in his experiments with Birmingham sewage on a more extensive scale than mine, shows a larger yield of ammonia and less loss of alumina.

A process for the extremely rapid oxidation of the effluent from precipitation by lime or alumina, by which it would be rendered entirely innocuous before being introduced into the river, and that at trifling cost, has been brought before me, but I am not at present at liberty to disclose the name of the inventor or the details of the process. I trust that it will be brought before the Society by the inventor during the present session.

Absorbent Power of some Pulverulent Bodies.—J. G. van Deventer.—Bodies in powder, in the same physical state, have different absorbent powers. The absorbent power increases with the thickness up to a certain limit. For each body there is a stratum of maximum absorption.—*Les Mondes.*

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, February 17th, 1881.

Prof. H. E. Roscoe, President, in the Chair.

After the minutes of the previous meeting had been read and confirmed, the President announced that the following changes had been proposed in the Council, &c., for the ensuing year:—Retiring Members—N. S. Maskelyne and R. Angus Smith from the list of Vice-Presidents:—C. W. Heaton, W. A. Tilden, J. L. W. Thudichum, and C. Graham from the Council. New Members proposed—A. Crum Brown and J. Emerson Reynolds as Vice-Presidents; C. Schorlemmer, G. H. Makins, C. M. Tidy, and F. T. Brown as Ordinary Members of Council. The following gentlemen were then elected as Auditors:—F. J. M. Page, J. M. Thomson, and R. C. Woodcock.

The following certificates were read for the first time:—J. F. Braga, H. Borras, T. C. Day, E. T. G. Gill, P. B. Mills, F. Tiemann, G. Valentine, A. Walker. During the evening a ballot for the election of Fellows was held, and the Scrutators, Drs. Hugo Müller and Stevenson, declared the following gentlemen as duly elected:—B. Akroyd, M. M. Bird, W. E. Benton, H. Baker, M. Benjamin, H. P. Cooper, W. H. Coffin, J. J. Eastick, H. W. Fenner, M. P. Gossett, S. Harvey, J. W. James, T. H. Judson, A. J. King, W. E. Kay, C. A. MacMunn, W. G. McMillan, W. J. Stavert, T. Takamatsu, P. Vieth, G. J. Wishart, R. W. Walker.

The President then called upon Mr. M. W. Williams to read a paper "*On the Estimation of Organic Carbon and Nitrogen in Water Analysis simultaneously with the Estimation of Nitric Acid.*" Of all the processes in use for estimating the organic matter in water, the safest and most thoroughly scientific in principle is perhaps that of Frankland and Armstrong. To this process as at present worked there are, however, some objections. The time required to evaporate the water is over twenty-four hours. The water is kept for a long time in contact with sulphurous acid, a portion of which may at any time be oxidised to sulphuric acid. There is no test by which to make certain that the nitric acid has been completely destroyed. A correction of some magnitude, calculated by an empirical method, has to be introduced to allow for the dissociation of ammonic sulphite. Moreover, nitrous acid, which is produced by the reduction of the nitrates by the sulphurous acid, attacks ammonia and amidated bodies in acid solution, evolving their nitrogen in the free state, and it is uncertain how far the nitrogen of the ammonia and of the organic matter in a water undergoing evaporation may be attacked in this way. The author proposes to avoid altogether the use of sulphurous acid, and to shorten very considerably the time required for a water analysis. The process consists essentially in converting the nitrates into ammonia by the copper-zinc couple, as described by the author at the previous meeting, distilling off the ammonia with the addition of a little sodium carbonate, and evaporating the residue in the retort to dryness for the combustion. The process may be briefly described as follows:—The zinc-foil is carefully cleansed from grease, &c., by boiling with dilute caustic alkali, and its surface freed from oxide by washing with acidulated water; it is then immersed in 3 per cent copper sulphate solution, as described in the previous paper. The copper-zinc couple is carefully washed, placed in a wide-mouthed stoppered bottle, and the water poured on and allowed to digest at the proper temperature until the reduction of the nitric acid is complete. About 1200 to 1300 c.c. of water are used. As nitrous acid is present in the liquid as long as any nitric acid remains, 100 c.c. of the water are withdrawn, and if a yellow colouration appears in half an hour after adding meta-phenylen-diamine and sulphuric acid a longer digestion is needed. If no colouration appears the reduction is complete. The remainder of the water is poured off from the copper-zinc couple into a tall cylinder, and decanted from any particles of copper and zinc. A litre is distilled in a glass retort until the distillate is free from ammonia, one or two drops of a strong solution of sodium carbonate being added. The ammoniacal distillate is Nesslerised, and, after deducting the quantity of ammonia originally present in the water, gives the quantity of nitric acid present. The water in the retort is further distilled to a low bulk, 200 c.c. Any carbonate of lime deposited is brought into solution by the addition of a little sulphurous acid. The water is then rinsed out into a smooth hemispherical basin, and evaporated to dryness on the water-bath. The residue thus obtained is free from all compounds of nitrogen except the organic matters contained in the water. The combustion of the residue is carried out as prescribed by Frankland and Armstrong. The author has employed the process with many waters having nitrates from 5 to 0·5 parts NO_3 in 100,000: the results agree with those obtained by the sulphurous acid method. The author claims for the process that it is free from the sources of error which accompany the use of sulphurous acid for destroying the nitrates, and that it is more rapid.

Mr. W. Thorp asked what precautions were taken to prevent the introduction of organic matter with the copper-zinc couple.

Mr. Williams said that it was very easy to exclude the possibility of such introduction if care was taken in making the copper-zinc couple.

Captain Abney then gave some account of some recent researches which he had carried out in conjunction with Colonel Festing, "*On the Influence of the Molecular Grouping in Organic Bodies on their Absorption in the Supra-red Region of the Spectrum.* The authors have photographed the absorption-spectra of numerous inorganic and organic solutions. The electric light was used. The portion of the spectrum photographed was beyond the red, which is of course under ordinary circumstances quite invisible. The focussing of this portion was attended with some difficulty, as nothing could be seen; successive trials had to be made until the photographs came out sharply defined. Three prisms were used, and the thickness of the layer of liquid was about 6 inches. Many of the photographs were thrown on the screen. Many of the organic radicles have in this ultra-red portion of the spectrum characteristic bands, or groups of bands, which run more or less through all their compounds; so that after some experience it is possible to say, from its spectrum, whether or not a chemical compound contains a certain organic radicle. The change produced in the absorption-spectrum of a substance by the addition of oxygen, nitrogen, &c., was pointed out. It is a curious fact that some of the well-marked absorption-bands of the benzene nucleus (857), of alcohol (900), and of water and chloroform (824) agree with some lines of the solar spectrum. The absorption-spectrum of hydrogen seems to be one of lines. The investigation seems likely to throw much light on the internal structure of organic substances.

The President said the subject was one of great interest, and as the investigation was still in its infancy, he must congratulate the authors on the results they had already obtained. As Dr. Russell and Mr. Lapraik had a paper on a somewhat similar subject, he would call on Dr. Russell to give his communication before entering on any discussion.

Dr. Russell then communicated some results obtained by Mr. Lapraik and himself, "*On Absorption bands in the Visible Spectrum Produced by Certain Colourless Liquids.*" The authors have carefully drawn the absorption-spectra of these liquids in long tubes (8 to 12 feet) in the visible part of the spectrum. The liquids examined included water, ammonia in solution in water, ether and alcohol, methylamine, &c. The bands in the spectra of ammonia and methylamine seem to be almost identical.

Dr. Armstrong pointed out how remarkably some of the photographs of Capt. Abney confirmed the views held by chemists as to the constitutional formulæ of organic bodies. These results afforded a proof that a chemical symbol represented not merely the behaviour of a substance, but gave a real picture of its internal structure. The spectrum of turpentine was exceedingly interesting. He should like to ask whether in the spectra of different radicles the bands were harmonics.

Capt. Abney, in reply, said that some of the bands nearly occupied the places of harmonics, but not quite. He should like to thank Dr. Hodgkinson on behalf of Col. Festing and himself for his valuable assistance in procuring the various liquids with which they had experimented.

"*On the Action of Hydrochloric Acid on Ethylene Alcohol*," by C. Schorlemmer. By heating glycol with an excess of fuming hydrochloric acid in a sealed tube to 100°, the author has converted this substance into ethylene dichloride, and has thus disproved the conclusion that the two hydroxyl groups had different functions.

"*On an Attempt to Accelerate the Process of Determining the Soluble Salts in a Soil*," by E. W. Prevost. The author added calcium sulphate and barium carbonate to the soil to expedite filtration, but in neither case were satisfactory results obtained.

The Society then adjourned to March 3, when the following papers will be read:—"On the Action of Bacteria on Various Gases," by F. Hatton; "On the Oxidation of Organic Matter in Water," by C. M. Tidy.

NOTICES OF BOOKS.

The Retrospect of Medicine: being a Half-yearly Journal containing a Retrospective View of every Discovery and Practical Improvement in the Medical Sciences. By W. Braithwaite, M.D., and James Braithwaite, M.D. Vol. lxxxii., July to December, 1880. London: Simpkin, Marshall, and Co.

This retrospect, valuable as it must be to the medical practitioner, contains but little to interest the chemist or the physicist. Perhaps the most widely-important memoir here quoted is one by Prof. Jos. Lister, F.R.S., on "Micro-organisms and their relation to Disease." Referring to the labours of Pasteur, Toussaint, Greenfield, and others, the author remarks that "if the British Medical Association should meet at Cambridge again ten years hence some one may be able to record the discovery of the appropriate vaccine for measles, scarlet fever, and other acute specific diseases of the human subject. But even should nothing more be effected than what seems to be already on the point of attainment—the means of securing poultry from death by fowl-cholera and cattle from the terribly destructive splenic fever—it must be admitted that we have an instance of a most valuable result from much-reviled vivisection."

An account is given of a remarkable case of hyperpyrexia in a young woman. Her blood temperature rose to 125·5° F., and still she lives and does well!

Year-Book of Pharmacy: comprising Abstracts of Papers relating to Pharmacy, Materia Medica, and Chemistry, from July 1, 1879, to June 30, 1880. London: J. and A. Churchill.

This volume contains an extensive selection of useful matter, most of which, however, as far as pure chemistry is concerned, will be well known to our readers. Some of the extracts placed under the head of pharmaceutical chemistry seem to have no valid title to such a position; *e.g.*, the vapour-density determinations of inorganic bodies at high temperatures, by V. and C. Meyer. Nor do we see why a method for ascertaining the purity of cream of tartar should be included under "Pharmaceutical Chemistry," whilst instructions for the examination of chloroform figure under "Pharmacy." We should venture to suggest that a separate section for analytical chemistry as applied to pharmacy would here be useful.

From the Presidential Address delivered at the last British Pharmaceutical Conference we quote the remark that the "fine old remedies and recipes that people used formerly for their minor complaints have very much succumbed before those all-promising, but mostly delusive, shams called patent medicines"—one of the many questionable features of our boasted "progress."

The most pleasing feature of this book is the proof it supplies how wonderfully the pharmaceutical profession has risen both in status and efficiency since the middle of the century.

CORRESPONDENCE.

ELECTRIC PAPER.

To the Editor of the Chemical News.

Sir,—In the Chemical News, vol. xliii., p. 39, I observe a note on what is called "Wiedemann's Electric Paper." Permit me to point out that most of those who have lectured on electricity for the last thirty years have been in the habit of using what is commonly called "Gun-paper" (pyroxylin made from Swedish filter-paper, a substance at one time largely used in making photographic collodion) for showing experiments in static electricity: I for one constantly employed it. I remember also that Faraday, in a lecture at the Royal Institution, made use of a piece of gutta-percha and a piece of gun-paper (or a film of collodion, I forget now which) as illustrations of the very different composition of substances from which electric sparks could be obtained by friction. The one being so carbonaceous that even in pure oxygen it burnt with a very smoky flame, the other containing so much oxygen that it exploded even in carbonic acid gas. Where is the novelty of M. Wiedemann's electric paper?—I am, &c.,

Chas. Heisch.

BENZOL TESTING.

To the Editor of the Chemical News.

Sir,—The discrepancies experienced in the testing of benzol, referred to by correspondents in recent issues of the Chemical News, are not I believe caused so much by defects or want of uniformity in manipulation, or in the kind of apparatus used,—though no doubt some small differences will arise due to these,—but must be ascribed principally to the neglect by some testers of the effect which the pressure of the atmosphere has on the boiling-points of liquids. Many years ago my attention was directed to the special effect which barometric pressure exercises on benzol, and ever since have made it a rule that its influence must always be considered when taking the boiling-points. The result of my experience is that in testing 30 or 50 per cent benzol 0·8 per cent, or nearly so, must be allowed for every degree which the barometer indicates at the time above or below the standard point. I take 30 inches as the standard, though perhaps 29·5 would be more fair as a medium standard point, but as a seller I prefer to err on the safe side, and take 30 inches.

A few days ago we were delivering some 30 per cent benzol, and as the barometer indicated here at the time of testing 28·6, we were obliged to give 42 per cent up to 100° C., knowing that if a rise in pressure took place, so that the barometer stood at 30 inches when the benzol reached the purchaser's hands, it would show about 30 per cent on testing.

If the barometric pressure is observed, and allowance made as I have briefly described, and ordinary care taken, there will be few disputes arising out of this matter. I have had this mode of testing in application during the last twelve or thirteen years at our works, and have not had one single substantiated complaint during the whole of that time.

The above rule should be applied only to 30 and 50 per cent benzols, to that portion of them which comes over up to 100° C.; the latter part of the distillate, as well as 90 per cent benzol, being affected ouly to a moderate extent by change of pressure.—I am, &c.,

J. D.

February 15, 1881.

DECOMPOSITION OF SLAGS AND SILICATES.

To the Editor of the Chemical News.

Sir,—I would caution chemists who intend to use the valuable process of Mr. Malvern W. Iles as to the action of caustic alkalies upon silver vessels. Eleven years ago, I worked at an identical process in a laboratory where gas was not obtainable, but had to discontinue the use of silver vessels owing to the complication of obtaining silver in solution, after separation of the silica by hydrochloric acid, by the solubility of chloride of silver in solutions of alkaline chlorides, and the trouble of estimating small quantities of lead and copper in presence of the silver as introduced.

The quantity I used was, however, nearer 5 than 50 grms. caustic alkali for fusions.

Such annoyances attendant upon the use of silver vessels for such fusions led me, some time after, to obtain a gold-lined platinum crucible, which worked admirably with both gas and spirit flames, and served to conduct oxidations with nitre and carbonates, fusions with bisulphates of potash and soda, and alkaline fluorides, as well as being used for general ignitions, roastings, &c., under the melting-point of gold. The price of the crucible was 42s. per oz.; which, considering its usefulness, was not expensive compared with platinum.—I am, &c.,

William Bettel.

Analytical Laboratory and Assay Office,
The Grove, Worcester.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, l'Académie des Sciences. No. 5, January 31, 1881.

Persistent Vitality of Carbuncular Germs, and their Preservation in Cultivated Soils.—M. Pasteur.—At a farm near Senlis, cattle which have died of carbuncular fever twelve years ago have been buried at a certain spot in a walled garden. Samples of the soil were lixiviated and concentrated, and guinea-pigs inoculated with the matter died quickly with well-marked symptoms of carbuncle. Of seven sheep allowed experimentally to pass a few hours daily on this spot, two died of the same disease in the course of six weeks, whilst the rest of the flock from which the seven had been taken remained healthy.

Action of Hydrochloric Acid upon Metallic Chlorides (a continuation from xci., p. 986).—A. Ditte.—The author examines the case where the presence of hydrochloric acid renders the chlorides less soluble, and which may be divided into two groups; one of these consists of salts very soluble in water, and which are deposited in the state of crystalline hydrates. The presence of hydrochloric acid diminishes notably the weight of chloride dissolved, but still leaves it considerable. The last group consists of chlorides which are almost insoluble in the concentrated acid.

Determination of the Colours Corresponding to the Fundamental Sensations by means of Rotatory Discs.—A. Rosenstiehl.—The author takes as his starting point a chromatic circle, drawn out on paper with 72 colours, the red, yellow, and blue being equidistant from each other, and the intervals filled with colours as equidistant as possible. Each colour may be regarded as a mixture of two others, and the author has undertaken to measure the two components of each. Supposing the orange to be a mixture of red and yellow, the author makes a disc of two concentric circles, the smaller formed of two sectors, the one orange and the other blue. The larger circle consists of a red sector, a white sector, and an empty space representing the absence of light, and they are made to revolve rapidly. The blue sector extinguishes the yellow of the orange and forms white, while the red remains alone. The measure of the two resulting sensations is given by the angle of the red sector and that of the white sector. The author found 140° orange + 220° blue = 218° red + 56° white. In this manner the chromatic circle has been divided into four sections. The line which represents the proportion of the extreme sensations in the intermediate colours is straight. The line representing the sensation of yellowness reaches its culminating point on the ordinate corresponding to the yellow. In the other colours the case is different. The sensation of red goes on increasing in a straight line line from the blue to the red, and continues ascending beyond without deviation as far as the orange, where it attains its culminating point. After this it lowers again as far as the yellow, where it is *nil*.

Determination of Carbonic Acid in the Air.—A. Muntz and E. Aubin.—The authors, after referring to the discordant results obtained in the determination of atmospheric carbonic acid, describe their method. The carbonic acid is fixed by an absorbent body, from which it is afterwards set at liberty and measured by volume. As absorbent they use pumice stone saturated with solution of potassa, and contained in a tube drawn out at both ends. The tubes are washed with sulphuric acid, filled with small fragments of pumice, calcined with sulphuric acid, and introduced while hot. The pumice is saturated with a given volume of potassa lye, operating in air deprived of carbonic acid. The lye is prepared by dissolving 1 kilo. potassa in 1·400 litres of water, and adding 200 grms. hydrated baryta to remove sulphates and carbonates. The tubes, prepared beforehand and sealed, are opened at the place of operation, and sealed again after 200 litres of air have been passed through.

Remarks on M. Eisenberg's Memoir on the Separation of Trimethylamin from the Bodies which Accompany it in the Trimethylamin Hydrochlorate of Commerce.—MM. Duvillier and Buisine.—A critique on a paper in the *Berichte der Deutsch. Chem. Gesel.*, xiii., 1667.

A Process for the Total Destruction of the Organic Matters in the Detection of Poisonous Mineral Substances.—A. G. Pouchet.—From 100 to 500 grms. of the suspected matter are mixed in a large porcelain capsule with one-fourth its weight of the acid sulphate of potassa, and then with its own weight of fuming nitric acid. The action is very violent at first, and requires afterwards the aid of a slight heat. Here it is proper to stop if it is merely needful to search for arsenic or antimony. A large excess of pure concentrated sulphuric acid (1·845 sp. gr.) is then added, and the mixture is heated to near the boiling-point of the acid. More acid is added from time to time till the mixture becomes pale and limpid. To complete the destruction of the last traces of organic matter it is well to let the liquid cool, add a few crystals of pure potassium nitrate, and heat again till abundant white vapours of sulphuric acid are evolved. The saline mass when cold is dissolved in boiling water, made up to 1 litre, and without previous filtration it is submitted to electrolysis by means of 4 Bunsen elements or a Clamond gas-battery. The negative platinum electrode becomes covered with a grey, blackish, or metallic coating. The action should be prolonged for twenty-four hours. If mercury is suspected a plate of gold should be used at the negative pole instead of platinum. If arsenic or antimony is sought for before the addition of the sulphuric acid, the carbonaceous mass is cooled, powdered, and treated with boiling water. The solution thus obtained is examined as proposed by Dr. A. Gautier (*Comptes Rendus*, August, 1875).

Bulletin de la Société Chimique de Paris,
No. 3, 1880.

Remarks on the Density of the Vapour of Iodine.—J. M. Crafts.—The results obtained by the author are quite comparable with those of M. Victor Meyer, and agree both for the lowest and the highest temperatures, but about 1000° M. Meyer finds the vapour-density of iodine = 5·76 to 6·16, as in his previous determinations, whilst the author obtains at the same temperature a density of about 7,—a discrepancy which he is unable to explain. He suggests certain modifications and precautions by which he hopes to arrive in concert with Prof. Meyer at definitive conclusions.

Action of Oxygenated Water upon Silver Oxide and Metallic Silver.—M. Berthelot.

Silver Teroxide.—M. Berthelot.

Observations on the Decomposition of Potassium Permanganate by Oxygenated Water.—M. Berthelot.—These three papers have been already noticed.

Reply to M. A. Gautier's Observations on the Author's Memoir on Methyl Cyanide.—C. Vincent and B. Delachanal.—The authors show that the question handled in their paper had not, as M. Gautier intimates, been solved previously.

Products of the Action of Soda upon Glycerin.—A. Fernbach.—In preparing propyl-glycol by this reaction, as recommended by Belohoubek, the author obtained as secondary products—methylic alcohol, ethylic, isopropylic, and propylic alcohols, and certain oily products, which from their small quantity could not be exactly separated.

Residues from the Manufacture of Oils from Schists. Gaston Bong.—The solid residues serve for the manufacture of alum, and may become an important source of lithia. The acid tarry matters contain sulphates of the bases of the pyridic series, especially of corindine, rubidine, and viridine. Aniline is not sensibly present. The insoluble portions and the alkaline tars contain peculiar phenols, thymols β and γ. There is no ordinary phenic acid, and very little thymol α.

Preparation of Pure Dimethyl Resorcine.—Oechsner de Coninck.—The author describes his process at length. He describes pure dimethyl resorcine as an oily liquid, colourless or slightly yellowish, of an ethereal odour, boiling at 210° to 212°, and of the sp. gr. 1·075 at 0°.

Bromine Derivatives of Nicotine.—R. Laiblin.—Not suitable for abstraction.

Les Mondes, Revue Hebdomadaire des Sciences.
No. 11, November 25, 1881.

Cork-cutters' waste is recommended as a material for the manufacture of gas.

MISCELLANEOUS.

Obituary.—We regret to have to record the death at Bridge of Allan, on 9th inst., of William Arnot, F.C.S., Analytical Chemist and Chemical Engineer, aged 38 years.

Wilts and Hants Agricultural College, Downton, Salisbury.—Mr. J. M. H. Munro, D.Sc. Lond., F.C.S., has been elected resident Professor of Chemistry in this College, and he will act in co-operation with Professor A. H. Church, M.A. Oxon. Dr. Munro headed the first-class Honours lists in Chemistry, at both the examinations for the B.Sc. Degree, and in 1874 obtained the Chemical Exhibition of the University; he was also classed in Botany and Vegetable Physiology, and in Logic and Moral Philosophy, and took the D.Sc. Degree in 1877. He recently received a grant from the Chemical Society, in aid of a research on which he is at present engaged.

MEETINGS FOR THE WEEK.

Monday, 28th.—London Institution, 5.
—— Medical, 8.30.
—— Royal Geographical, 8.30.
Tuesday, 1st March.—Royal Institution, 3 p.m. "The Blood," Prof. Schäfer.
—— Civil Engineers, 8.
—— Medical and Chirurgical (Anniversary), 8.30.
—— Society of Arts, 8. "Languages of Africa," Mr. Robert N. Cust.
Wednesday, 2nd.—Society of Arts, 8. "Lighthouse Characteristics," Sir William Thomson, LL.D., F.R.S.
—— Pharmaceutical, 8.
Thursday, 3rd.—London Institution, 7.
—— Royal, 4.30.
—— Chemical, 8. "On the Action of Bacteria on Various Gases," Mr. F. Hatton. "On the Oxidation of Organic Matter in Running Water," Dr. C. M. Tidy. "On the Action of Aldehyds on Phenanthrene-quinon in Presence of Ammonia (Second notice)," Dr. F. R. Japp and Edgar J. Wilcock. "On the Action of Benzoic Acid on Napthaquinon (Preliminary notice)," Dr. Japp and N. H. J. Miller.
—— Royal Institution, 3. "Cuneiform Characters," Rev. W. Houghton.
Friday, 4th.—Royal Institution, 8. "Elasticity," Sir William Thomson, 9.
—— Geologists' Association, 8.
—— Society of Arts, 8. "The Results of British Rule in India," Mr. J. M. Maclean.
Saturday, 5th.—Royal Institution, 3. "Ancient Egypt," Mr. R. S. Poole.

Errata.—Page 84, line 36 from top, *for* "thermic sulphocyanate" and "thermic oxalate" *read* stannic sulphocyanate and oxalate in each case.

SOLAR PHYSICS.

The following Courses of Lectures will be given by Members of the Committee on Solar Physics, appointed by the Lords of the Committee of Council on Education:—

An Introductory Lecture. By Professor Stokes, Sec. R.S. 6th April, 1881.

A Lecture on the Practical Importance of Studying the Influence of the Sun on Terrestrial Phenomena. By Lieut.-General Strachey, R.E., C.S.I., F.R.S. 8th April.

Two Lectures on the Connection between Solar and Terrestrial Phenomena. By Professor Balfour Stewart, F.R.S. 27th and 29th April.

Six Lectures on Spectroscopy in Relation to Solar Chemistry. By Mr. J. Norman Lockyer, F.R.S. 4th, 6th, 11th, 13th, 18th, and 20th May.

Three Lectures on the Photography of the Infra-red of the Spectrum in its Application to Solar Physics. By Captain Abney, R.E., F.R.S. 25th and 27th May and 1st June.

The Lectures will be delivered in the Lecture Theatre of the South Kensington Museum, at 4 p m., on the days stated above.

Admission will be by Tickets, which may be obtained, as far as there is room, on application by letter to the Secretary, Science and Art Department, South Kensington, S.W.

AMMONIACAL LIQUOR.

THE DIRECTORS OF THE BRISTOL UNITED GAS LIGHT COMPANY invite TENDERS for the PURCHASE of the AMMONIACAL LIQUOR made at all or either of their THREE STATIONS, situate respectively at AVON STREET, CANONS' MARSH, and STAPLETON ROAD in the Borough of Bristol, for a TERM of FIVE or SEVEN YEARS, commencing on 1st JULY, 1882.

The Annual Quantity of Liquor produced at present at the three Stations is about 2½ millions of gallons.

Conditions of Contract and other particulars may be obtained of e SECRETARY, at the Office of the Company, Canon's Marsh, Bristol.

Tenders to be delivered on or before TUESDAY, 3rd day of May next, addressed to the Chairman of the Company, and marked 'Tender for Ammoniacal Liquor."

The Directors do not bind themselves to accept the highest or any Tender.

HENRY H. TOWNSEND, Secretary.

Gas Offices, Canons' Marsh, Bristol,
8th January, 1881.

SPECIALITIES.

MANGANESE—Finest Crystallised, Lump, Ground, and Granulated of every quality, and PREPARED for *Chlorine, Glass, Steel, Ferro-Manganese Pottery, Battery*, and EVERY PURPOSE.

BAUXITE—(Hydrate of Alumina) Of high percentage of Alumina and almost free from Iron The CHEAPEST, BEST, and MOST PROFITABLE article from which to produce ALUM, ALUM CAKE, and SULPHATE OF ALUMINA, &c. [BRAND, "IRISH HILL BAUXITE."]

FLUOR-SPAR—Of the Very Finest Quality for Acid, Soda, Glass Flux, and all purposes

BARYTES—(Carbonate and Sulphate. Crystallised, Selected Lump and Ground for all uses.

CRYOLITE—Magnesite, Felspar, Arsenic, Phosphates, French Chalk, Strontia, Wolfram, Chrome, Terra Alba, Rotten Stone, China Clay, Umbers Ochres, Antimony, Calamine, Emery Stone all Oxides, and all

FULLER'S EARTH—Of superior quality, and entirely free from grit. [BRAND, "EMERALD."]

MINERALS, CHEMICALS, AND COLOURS.

GEO. G. BLACKWELL,

MINE PROPRIETOR,

Manganese and Mineral Works, Grinding Mills, and Ore Yards, GARSTON.

OFFICES—26 CHAPEL STREET LIVERPOOL.

TETRACHLORIDE OF CARBON.
BISULPHIDE OF CARBON.
CHLORIDE OF SULPHUR.

JESSE FISHER & SON,
Phœnix Chemical Works Ironbridge.

MOTTERSHEAD & CO.,

7, Exchange Street and 10, Half Moon Street,
MANCHESTER.

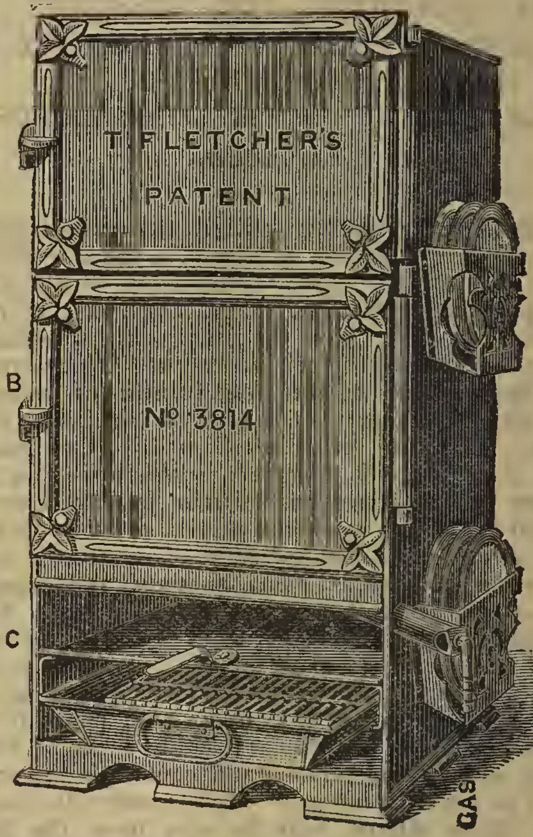
CHEMICAL & PHYSICAL APPARATUS,
BOTTLES, PURE CHEMICALS,
REAGENTS, STANDARD SOLUTIONS,
And Every Requirement for Works' or School Laboratories or Private Students.

Illustrated Price Lists on application.

Wanted, to Purchase Volumes 1, 3, 5, 6, and 7, of the 'Journal of the Chemical Society"; also Vol. 3 of the "Proceedings of the Royal Society."—Address, K. P. G., CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.

FLETCHER'S
PATENT VENTILATED
HOT-AIR OVEN.

At a cost of less than one halfpenny per hour for gas, this oven will grill, roast, toast, bake, warm dishes and plates; and with the assistance of Fletcher's Patent Solid Flame Boiling Burners will do everything possible with a first rate open fire (except drying clothes on washing days).



It is unapproached by any oven for pastry, and is fully hot in one minute after the gas is lighted.

Fish, joint, and pastry can be cooked all at once, in the most perfect manner, without the slightest taint from one to the other. The cooking is always good and always alike.

It will roast joint and fowls both at once, at least as well as an open fire.

Complete illustrated list of gas cooking and labour saving appliances free by post. List of Gas and Petroleum Laboratory Furnaces and Apparatus, price 2d.

THOS. FLETCHER,
4 & 6, MUSEUM STREET, WARRINGTON.

MR. J. S. MERRY
ASSAYER AND ANALYTICAL CHEMIST.
SWANSEA.

THE CHEMICAL NEWS
AND
JOURNAL OF PHYSICAL SCIENCE.

Edited by WILLIAM CROOKES, F.R.S.

Published every Friday. Price 4d. Annual Subscription, post free including Indices, £1

CHARGES FOR ADVERTISEMENTS.

	£	s.	d.
Five lines in column (about 10 words to line)	0	3	6
Each additional line	0	0	6
Whole column	1	15	0
Whole page	3	0	0

A reduction made for a series of insertions.

Cheques and Post-Office Orders, crossed "London and County Bank," payable to the order of William Crookes.

BOY COURT, LUDGATE HILL LONDON, E.C

THE CHEMICAL NEWS.

Vol. XLIII. No. 1110.

UPON THE INVARIABLE PRODUCTION, NOT ONLY OF OZONE AND HYDROGEN PEROXIDE, BUT ALSO OF AMMONIUM NITRATE, IN THE OZONATION OF PURIFIED AIR BY MOIST PHOSPHORUS.

By Dr. A. R. LEEDS.

As the result of very numerous quantitative experiments performed two years ago, and published in the Chemical News, vol. xl., p. 70 ("Upon Ammonium Nitrite, and upon the By-products Obtained in the Ozonation of Air by Moist Phosphorus"), I gave the proofs of the statement contained in the heading of this article, and the determinations of the amounts of the three substances formed. Forthwith, under the title "Is Ozone Produced during the Atmospheric Oxidation of Phosphorus?" (Chemical News, vol. xl., p. 96), Mr. Kingzett, without waiting to disprove any of the above propositions by experiment, asserted that "*There is no known process of slow oxidation which has been established to produce ozone*," and that the gaseous body which I had obtained and experimented upon, was altogether peroxide of hydrogen. Mr. Kingzett insisted that the long series of wash-bottles and purifiers, which I had used to absorb and hold back, as far as possible, the hydrogen peroxide, did not militate at all against his assumption, for the reason that peroxide of hydrogen suspended in a vesicular condition, might pass through all the washing liquids, and constitute the only active agent in the escaping gas. How greatly Mr. Kingzett's views have altered may be seen from the fact ("Report upon the Atmospheric Oxidation of Phosphorus, &c.," *Journ. Chem. Soc.*, Dec., 1880) that the points most dwelt dwelt upon by him in this last paper are that the escaping gas contains no peroxide of hydrogen whatsoever, but consists entirely of ozone, and that "the peroxide of hydrogen formed in the process is entirely deposited in the water contained in the oxidisers; and if it cannot escape condensation in the aqueous spray and vapour of the oxidisers, it cannot be expected to escape solution in five wash-bottles."

Since the statements of Mr. Kingzett, now, are diametrically opposed to those which he made when he attacked my results in the beginning, I think it will facilitate the labours of future workers in this field, if I present a brief summary of the facts hitherto established.

When I first entered upon the study of the phenomena exhibited in the aërial oxidation of moist phosphorus (October, 1878), the first difficulty encountered arose from the unsatisfactory character of the apparatus previously employed, and the impossibility of obtaining a stream of ozonised air containing a uniform and definite percentage of ozone. These difficulties disappeared when it was ascertained that the volume of ozone produced, under given conditions, was a definite function of the temperature, and might accordingly be expressed by a curve, having its origin at 6° C., at which temperature the production was *nil*, and arriving at its maximum at 24°, from this point falling off again rapidly. The manipulation was rendered easy by the phosphorus ozonator, described along with the volume-temperature experiments (Chemical News, vol. xl., 157). These results were referred to by Mr. Kingzett in vol. xl., p. 96; and yet in his earlier experiments performed long subsequently (vol. xli., p. 98), he states that he obtained no satisfactory evidence of the production of ozone, and but little evidence of the production of peroxide of hydrogen. Later on, when working in summer weather, Mr. Kingzett obtained better results, and discovered that his previous failures had been due to his having conducted the experiments at too low temperatures.

In plotting the volume-temperature curve, the water in the jars of the ozonator was replaced by a solution of potassium bichromate and sulphuric acid of such strength that the surface of the phosphorus was kept clean without undergoing the danger of ignition from too concentrated acid and too rapid oxidation. Mr. Kingzett states that "such a method of experiment obviously precluded examination for peroxide of hydrogen in this solution in which the phosphorus was partially submerged, and explained why he found the relation of peroxide of hydrogen to ozone as 1 : 400"! The comment of Mr. Kingzett would have been only too just if I had looked, or proposed to look, in an acidified potassium bichromate bath for undecomposed hydrogen peroxide. But Mr. Kingzett, who criticised both papers at length (*loc. cit.*), must have known at that time, a year and a half ago, though apparently he has since forgotten that I did not employ such a method. The potassium bichromate bath was employed in the determination of the volume-temperature curve of the evolved ozone only, and in that investigation no attempt was made to determine the hydrogen peroxide formed. That question was taken up at great length in the subsequent paper upon "Ammonium Nitrite, and the By-products obtained in the Ozonation of Air by Moist Phosphorus." In the experiments therein detailed, and in which the determination of the hydrogen peroxide in the ozonising chambers and in the various wash-waters is expressly considered, not merely water, but water especially purified for the purpose, was employed. This and many other precautions were essential at that time, when the exact nature and extent of the sources of error were unknown. And since these sources of error are not even alluded to, nor suitable precautions to obviate them taken, by Mr. Kingzett in his paper, it will be necessary to emphasize them here.

At that time, and even now, the generation of ammonium nitrite by evaporation of water was, and is taught as, an established fact. If this were indeed the case, the ozonising chambers present the most favourable conditions for its generation, and the nitrite thus formed would give the same reaction as hydrogen peroxide or ozone when we came to titrate the water in the ozonisers with an acidified solution of potassium iodide. The elaborate experiments of Bohlig, Zabelin, and Carius, however, have shown that this is not true, and that the alleged formation of ammonium nitrite by evaporation of water in air, never takes place when adequate precautions are taken to exclude from the evaporated water the ammoniacal compounds pre-existent in the atmosphere. Fortunately, therefore, this source of errror was not inherent in the experiments themselves, and it only remained to guard against it by very complete washing of the air drawn through the ozonator.

Again, Goppelsröder and Carius had shown that when ammonia is brought into contact with ozone, it is decomposed with the formation of ammonium nitrite, ammonium nitrate, and peroxide of hydrogen. It was essential, therefore, that the phosphorus should be in contact with water from which every trace of ammonia had been expelled. If this were not done, the origin of any ammonium compounds or hydrogen peroxide found among the products of the reaction, would be rendered doubtful. It was for this reason that all the water employed in my experiments, in which a determination of the hydrogen peroxide was attempted, was *aqua purissima*, that is water re-distilled until it did not give the slightest reaction for ammonia when treated with Nessler reagent.

Moreover, while the oxidation of water to hydrogen peroxide by *free* ozone had been abundantly disproved, yet there appeared to be much reason for supposing that during the aërial oxidation of moist phosphorus, a formation of hydrogen peroxide actually took place. If this were true, its origin could not be ascribed to a secondary action due to the ozone first formed, but to the same series of changes as those which led up to the oxidation of the oxygen molecule itself. The only sufficient assignable cause was the formation of nascent oxygen, or oxygen in the atomic condition, such as it must necessarily enter into during some moment of the chemical change, when a substance of uneven quantivalence like phosphorus undergoes oxidation. That oxygen in an uncombined or monatomic condition might peroxidise the water molecule, while oxygen already combined in a triatomic molecule might not, appeared to be a legitimate hypothesis. That nascent oxygen might oxidise the nitrogen molecule at the same time, and generate, in the presence of water, ammonium nitrate, I regarded likewise as a not improbable supposition. For this reason, excessive care was taken to preclude the presence of atmospheric ammoniacal or nitrous compounds, both in the air drawn through the ozonator, and also in the water brought into contact with the phosphorus in the ozonator jars.

The mental picture which was formed at that time of the sequence of phenomena to be studied, was embodied in the following four equations, the last three being imagined as contemporaneous :—

$$1.\ P_4+O_{14}=P_2O_5+P_2O_3+2O_2+O+O.$$

$$2.\ O_2+O=O_3. \quad 3.\ HOH+O=HO-OH.$$

$$4.\ NN+2H_2O+O=NH_4NO_3.$$

The experiments performed now two years ago, and the repetition of which, though in an imperfect manner, and with the neglect of essential precautions, constitutes the substance of Mr. Kingzett's report to the Chemical Society above alluded to, were framed with a view of testing the truth or falsity of the above propositions. What these experiments actually were may be seen by inspection of the accompanying scheme of them, which, with one exception, was followed to the letter :—

1. Use of a measured amount of *aqua purissima* in the ozonator jars.
2. Complete straining and washing of the air by means of cotton-wool, *aqua purissima*, caustic soda, and sulphuric acid, both of the latter previously tested and shown to be free from nitrogen compounds.
3. Weight of the phosphorus cakes before and after the experiments.
4. Amount of ammonia in the jar-water at the close of the experiment.
5. Amount of the nitrites and nitrates, as determined by reduction.
6. Amount of nitrous acid, as determined by meta-diamido-benzol.
7. Amounts of phosphoric and phosphorous acids, and of *hydrogen peroxide in the jar-water* (ozonising chambers).
8. Estimation of ammonia, nitrates and nitrites, nitrous acid alone, phosphoric acid, phosphorous acid, and hydrogen peroxide, in the water used to wash the escaping products of ozonation.
9. Similar estimations, except of the phosphorus compounds, in the solutions used to wash the entering air.
10. Measurement of total volumes of air used and of ozone after its escape from the water employed in washing.

With regard to the first two heads of this scheme it is to be noted that the *proof* of the exclusion of all compounds of nitrogen from the substances entering into the reaction was essential to establishing this vital fact :—That any nitrogen compounds found among the *products* were the results of chemical changes induced in the process of ozonation itself. That this preliminary proof was of the highest importance was shown by the results of the investigation : it was found that while no ammonium nitrite was present in the water of the ozonising chambers or in the wash-water, of ammonium nitrate a considerable amount (27·39 m.grms.) was present in the first, and a determinable quantity (0·31 m.grm.) even in the latter. Until adequate experimental evidence, therefore, is adduced to the contrary, the formation of ammonium nitrate during the ozonation of purified air by moist phosphorus is to be regarded as a fact which cannot be overlooked, and one which demands an explanation in any theoretic account of the chemical phenomena involved.

Mr. Kingzett, however, does not even contemplate the possibility of the nitrogen, which is relatively the most abundant of the substances present, taking part in the reaction. To say nothing of the fact that his arrangements for washing the air were inadequate, there is no proof given that the water used by him in contact with the phosphorus was pure. If it was ordinary distilled water it certainly was not pure, but contained the very body (ammonia) which was the worst possible impurity, so far as the question at issue was concerned. Not to speak of the discovery of Goppelsröder and Carius, that ammonia is converted by ozone into hydrogen peroxide and the nitrate and nitrite of ammonia, no experiment is narrated by Mr. Kingzett in which he sought to determine whether nitrous acid was present or not in any of the liquids examined. In the entire absence of such tests his determinations of the amounts of hydrogen peroxide, &c., are correspondingly incomplete. That this is not hypercriticism is shown by the fact that the dense white fumes which are seen in the ozonising chambers were at one time attributed by Schönbein to ammonium nitrite.

By referring to the seventh head of the scheme it will be seen that the determination of hydrogen peroxide in the ozonising chambers was expressly mentioned, and as preliminary to this determination experiments were made upon the possible influence of phosphorous acid upon the titration for the peroxide, and elaborate pains were taken to prove the absence of nitrous acid in the water examined. My surprise was very great on finding, after the publication of the paper, that while the hydrogen peroxide in the wash-water and every other point in the scheme had beed determined, this particular estimation had been overlooked. For this reason, in every communication written subsequently, I have never committed myself to any statement as to the total amount of hydrogen peroxide produced, knowing that it was the sum of three quantities :—(1) That referred to under the seventh head, which remains behind in the jar-water; (2) that carried forward in a state of aërial suspension, and partly detained by the wash-water; (3) that escaping along with the ozone in the evolved gas. Mr. Kingzett has called my attention to the oversight in carrying out this important part of the general scheme, and has made some estimations of the amounts of hydrogen peroxide in the ozonising chambers. Unfortunately, from his use of an acidified solution of potassium iodide as a reagent for titrating the evolved gas, and from his having employed a fan to blow the air through the apparatus without indicating the method of measuring the air, I am unable to use his results.

In my own experiment, in which 56 litres of purified air were drawn through the ozonator, the jars containing pure water, the amount of ozone in the evolved gas was 44·47 m.grms., that of hydrogen peroxide in the jar-water 35·69 m.grms. This would give for the ratio of the ozone to the hydrogen peroxide, in this particular experiment, 1 : 0·8, or by molecules ($O_3=H_2O_2$) as 1 : 0·8.

In my earlier paper (August, 1879) the amount of ozone in the evolved gas bore to the amount of peroxide of hydrogen the ratio of 400 : 1. In these experiments it was supposed that a long series of wash-bottles was sufficient to wash out the aërially suspended hydrogen peroxide, and hence the number 400 : 1 was taken as expressing the relation between the total quantities in the gas after its escape from the ozonising chambers. No statement was made, either then or subsequently, as to the total amount of hydrogen produced (owing to my original oversight in failing to determine it in the water of the ozonising chambers), but only to the amount in the evolved gas.

Subsequently, after much more elaborate experiments (Chemical News, vol. xlii., p. 19), this assumption was found to be false, and that after passing not only through the wash-bottles, but a length of sulphuric acid dryers so great that every trace of moisture was removed, the ratio of the ozone to the hydric peroxide in the *evolved gas* was far less than 400 : 1. In the last and best agreeing series of trials it was as 51 : 31, or 1 : 0·67. The ratio of the ozone to the water formed by the decomposition of the hydrogen peroxide with the aid of heat (at 200°) was 51 : 18, or approximately 3 : 1. This ratio was accidentally given instead of the former in stating the result of the trials (*loc. cit.*).

But it will be asked what proof is there that the neutral solution employed in titrating the current of ozone and hydrogen peroxide would indicate the ozone only and not the peroxide as well? The answer is to be found in the fact that hydrogen peroxide held in vesicular suspension will pass through neutral potassium iodide solution without causing any appreciable decomposition in the latter. This was verified in the following experiment (*Jour. Amer. Chem. Soc.*, ii., 157):—"Perfectly pure and dry oxygen was ozonised by one of the 'ozonising elements" (electrical ozonisers), and then drawn through three bulbs, the first containing a solution of neutral potassium iodide, the second water, and the third chromic acid. The latter was connected with an aspirator. As soon as the strongly ozonised oxygen came into contact with the potassium iodide, a very slow current being employed, a yellow colouration made its appearance on the surface of the solution in the first bulb, and above the surface the characteristic white cloud. On increasing the rapidity of the current this white cloud was drawn through the water and chromic acid into the aspirator, and remained for one or more hours before its absorption was complete. After drawing over 6 litres of oxygen, containing 0·194 grm. of ozone, the water was titrated, and found to have absorbed 0·31 m.grm. of peroxide of hydrogen. The chromic acid solution was unaffected, showing that the suspended hydrogen peroxide may pass through it without effecting a decomposition. The same remark applies to a neutral potassium iodide put in the place of the chromic acid. The excessively dilute hydrogen peroxide held in a state of aërial suspension was not able to decompose the neutral iodide during the course of the experiment. Of course an *acidified* solution could not be employed to absorb the peroxide, since, as above shown, its decomposition occurs under the action of oxygen alone."

The conclusion, therefore, to be drawn from the above results is, that in the ozonation of air by moist phosphorus the number of molecules of hydrogen peroxide approximates very nearly to an equality with the number which is, *pari passu*, formed of molecules of ozone. That it does not fully equal this number may possibly be connected with the production, as the third essential result of the action of nascent oxygen under the circumstances studied, of a certain amount of ammonium nitrate. And not only does this relation exist between the amounts of ozone and hydrogen peroxide *produced*, but subsists, with little alteration, after the two bodies have been passed through many wash-bottles, and have been for a considerable interval in contact with one another in the *evolved* gas.

Now that I have reviewed my own labours in this direction, I wish briefly to examine Mr. Kingzett's statements concerning them.

After incorrectly stating that I looked for hydrogen peroxide in an acidified potassium bichromate bath, Mr. Kingzett adds:—"Moreover, it is not apparent from his various communications that he subjected his gaseous product to any very special examination. He seems to have relied upon its odour and general characters rather than upon any exclusive properties, as evidence of its nature."

In the first place, with regard to the odour, Mr. Kingzett has apparently overlooked the fact that, unlike his present position, which is that the body evolved is all ozone, and contains no hydrogen peroxide, he maintained at that time the opposite,—that the gas evolved was altogether hydrogen peroxide, and contained no ozone. And the only connection in which I have brought forward the smell of ozone, as an important physical quality, was to state that attention to it might have prevented Mr. Kingzett from so positively affirming that a gas which possessed the powerful and unique smell of ozone was not ozone, but another body, viz., hydrogen peroxide, which is entirely odourless.

In the next place, Mr. Kingzett has brought forward only two tests which differ from those which I have applied. The first consisted in passing the ozonised air through turpentine, and assuming that the failure of the gas, after its passage to set free iodine in a potassium iodide solution, demonstrated that it originally contained ozone only. But until it has been shown that the hydrogen peroxide suspended in the gaseous current would not undergo absorption by the oil of turpentine as well, the proof is valueless.

That this absorption would probably take place may be inferred from the action of organic liquids in general; for when the current of ozonised gas is passed into alcohol, ether, or glycerin (*Journ. Amer. Chem. Soc.*, i., 448), the white cloud entirely disappears, and hydrogen peroxide is found in the liquid. In this respect the organic liquids strikingly differ from solution of potassium iodide, water, acidified chromates, &c., inasmuch as the latter do not arrest the suspended hydrogen peroxide.

Mr. Kingzett's second novel test consisted in heating the ozonised air to 240°, and assuming that the entire destruction of the active agent at this temperature proved that it was ozone. The information to be derived from heating the gas, under proper conditions, is perhaps the most conclusive of any that can be obtained, as to its true nature. But, as Mr. Kingzett has applied the test, he has deprived it of the very conditions essential to its value. For at 240° not only ozone, but also peroxide of hydrogen is destroyed, and there is nothing in the test, as he has applied it, to prove that the active agent was ozone only, or peroxide of hydrogen only, or a mixture of both.

Prior to this I had made use of the same test (Chemical News, xlii., 19), but in a different manner. The ozonised air, after extended washing, was completely desiccated, and then exposed to temperatures running from the ordinary up to 200°. It was shown that as the reaction for ozone diminished, with the successive increments of temperature, the quantities of water derived from the decomposition of the suspended hydrogen peroxide as regularly increased. The numbers obtained by experiment exhibited this diminution of ozone and increment of water as uniformly as was to be reasonably anticipated in view of the difficult nature of the work. The total amount of water obtained in twelve experiments was 0·0086 grm., corresponding to 0·016 grm. hydrogen peroxide: the total amount of water obtained in blank experiments continued for a much longer time than those reported, and differing from the latter only in the circumstance that the phosphorus cakes were kept submerged beneath the surface of the water in the ozonator jars, was zero. We have seen with what neglect of essential precautions Mr. Kingzett has applied this test: against my results he has to urge merely his conviction (!) that they were wrong, and that the amounts of water weighed were due to water only, and not to H_2O_2. It is hardly worth while to comment—0·016 grm. is a ponderable quantity, the reality of which is capable of experimental proof or disproof, whilst a conviction is not necessarily of any weight except in the mind of its author.

The only experiment which Mr. Kingzett has brought forward in this connection shows that he has failed to apprehend the real question at issue. He passed a rapid current of air through a solution of hydric peroxide, and inferred that the failure of the air, after its passage, to effect a noteworthy decomposition in an acidified potassium iodide solution, proved (what it did not) that no H_2O_2 could be carried forward when the H_2O_2 was in a *state of aërial suspension*. Mr. Kingzett's experiment is a repetition of a similar one of my own published previously (*Journ. Amer.*

Chem. Soc., ii., 154), but illustrates merely the well-known fact that hydrogen peroxide is a difficultly vapourisable body. Mr. Kingzett appears to think that the use of a *rapid* stream of air had some bearing upon the question, and speaks of a spray of peroxide of hydrogen. The phenomena which is under investigation cannot be studied in this manner. The state of vesicular suspension of the hydrogen peroxide is not one which, so far as we are at present aware, can be brought about by mechanical means, but is one which hydrogen peroxide assumes only when it is the immediate result of a previous chemical change. This is its condition when formed in the phosphorus ozonator, and likewise when ozone undergoes decomposition in presence of water, as when it is absorbed by a solution of potassium iodide, and is the origin of the white cloud seen under these circumstances over the surface of the latter.

The difference between the two conceptions Mr. Kingzett would have noted had he been acquainted with what is the most striking reaction which occurs during the ozonation of air by moist phosphorus. This is the permanent white cloud which fills the ozonator, and is carried forward through an extensive series of wash-bottles, and remains sometimes for hours without undergoing absorption above the surface of the water in an aspirator employed to draw air through the apparatus. This white cloud was the antozone of Schönbein, which he—and after him Meissner—laboured unsuccessfully for so many years to account for. For our knowledge of its true nature we are indebted mainly to Von Babo, and after him to Nasse and Engler, who demonstrated that the so-called antozone is merely hydrogen peroxide in a state of vesicular suspension. The stumbling-block which rendered of so little value the life-long labours of Meissner upon this question was that, starting out from the well-established fact that hydrogen peroxide is not volatile, he concluded that the clouds could not be due to this substance. As the only alternative, he and Schönbein ascribed them to a peculiar modification of oxygen, other than ozone. There is danger of our giving up ground acquired with great difficulty, and falling back into hopeless contradictions, if we do not keep clearly in mind the distinction between hydrogen peroxide in its ordinary condition, in which it is not volatile, and hydrogen peroxide as suspended at the moment of its formation, in a current of air or aqueous vapour. An atmosphere saturated with aqueous vapour is most favourable to the existence of the hydrogen peroxide in a state of vesicular suspension, but is not essential, since after complete withdrawal of the water vapour the suspended hydrogen peroxide will still be present.

Summary.

1st. Both ozone and hydrogen peroxide are produced during the ozonation of purified air by moist phosphorus, in the ratio approximately of one molecule of the latter to one of the former.

2nd. Both bodies are evolved, the suspended hydrogen peroxide passing through a series of wash-bottles without undergoing any but a slight absorption, and being present in the evolved gas in nearly the same ratio as that which it held to the ozone when originally produced.

3rd. Along with these two bodies, and as a necessary part of the same series of reactions incident originally to the setting free of nascent oxygen, a certain amount of nitrate of ammonium is invariably produced. This last is altogether detained in the water of the ozonator and of the wash-bottles.

Examination of Materials from certain Vitrified Forts in France.—M. Daubrée.—The fusion of the materials composing these forts, especially those of Creuse and Côtes du Nord, which are formed of granite, testify to a surprising skill and knowledge of the management of fire on the part of their makers.—*Comptes Rendus.*

ON THE
DETERMINATION OF BASIC CINDER AND OXIDES IN MANUFACTURED IRON.

By WILLIAM BETTEL,
Late Public Analyst for Middlesbro'.

The principal value attached to determinations of slag and oxides in defective iron is the almost absolute certainty of discovering whether to the chemical constituents of the metal or to its careless manufacture may be attributed the faults observed. When we contrast the "life" of an iron rail of fair chemical purity with "mild" steel rails of nearly the same composition, it is forcibly suggested to even the most superficial observer that the duration of a rail is proportionate to the cohesion of its metallic particles, due principally to freedom from mechanical impurities. Compare iron rails made from Swedish iron, in active use for over forty years on the Great Western line near Oxford, with rails made by Danks's or any other equally good process, both presumably of the same purity, but entirely different in mechanical value.

Engineers have ever been alive to the necessity of suitable machinery for expressing the fluid cinder from the iron as it comes from the puddling and re-heating furnaces, but how rarely is the determination of cinder asked for at the hands of the analyst. We occasionally find extremely pure irons and steels—pure at least by the result of routine analysis—which are condemned when subjected to mechanical tests. In some cases a crystalline structure of the metal, perhaps in conjunction with occlusion of H, N, or CO, may weaken the iron, but it is usually the cinder which, by breaking the lines of continuity in molecular structure of the metal, determines its fracture.

We regularly determine the ordinary chemical constituents of a manufactured iron, why not its contained oxides of manganese and iron and basic cinder, which, when present in excess, weaken the iron, and so detract from its value?

The cause of the omission seems to be that no process with the exception of Eggertz's, is suitable for technical work. Fresenius's process is, without doubt, accurate, but what process can be admitted into an industrial laboratory (where a complete analysis is required in two days or less) which, for each experiment, requires a rod of the metal and several days for the completion of the analysis.

Eggertz's bromine process, although permitting the use of iron in a fine state of division, requires the employment of cooling media—not always at hand—in order to avoid the formation of basic bromides. When we consider the stability of ferric chloride at high temperatures in presence of water and excess of alkaline chlorides, due to the formation of double salts, it naturally occurs to us that the stability of solutions of bromides of iron, &c., would be ensured at a moderately high temperature in presence of excess of alkaline bromides. Again, considering the compounds of iodine with iodide of potassium, we infer that a solution of bromine in presence of an alkaline bromide will not volatilise so rapidly when heated as if free. The precipitation of manganese as oxide and basic bromide, although by this means greatly retarded, is not entirely prevented, as shown by the amount of manganese in the insoluble residue. We must therefore, after filtration, ensure its subsequent solution by reagents capable of attacking cinder and *ignited* oxides in only a very slight degree. A determination of cinder, &c., by the following method only occupies an hour or so, and has the advantage of yielding constant results :—Five grms. of the borings are heated with a solution of 10 c.c. bromine and 35 grms. KBr in 150 c.c. water. Heat is continued until the iron is dissolved, the solution filtered through a 4″ Swedish paper previously washed with HCl and boiling water), drained, and washed with a solution of SO_2 containing 5 per cent HCl. When the filtrate is practically free from iron, wash with boiling water containing ½ per cent HCl, then with pure water, rinse into small Pt dish, evaporate to low bulk, and dissolve out silica by means of hot solution of carbonate of soda. Boil, dilute, filter, wash with hot water, then with a ½ per cent solution of HCl, finally with water. Dry, ignite, and weigh. Determine the silica in the residue in the ordinary manner. The bromine in the first filtrate may be recovered as bromide of potassium in an obvious way.

Some analysts object to the Br process on account of the vapour contaminating the air of the laboratory. To those I would recommend the following process, which has given good results in my hands:—Five grms. of the iron, rather finely divided, are dissolved in 60 c.c. clear solution of $CuCl_2$ (1 in 2), mixed with 100 c.c. saturated solution of KCl. When no particles of iron can be felt by the aid of a glass rod, add 50 c.c. of dilute HCl (1 in 20), boil, and filter through a 4″ Swedish paper (previously moistened with hot HCl (1 in 3), then with saturated solution of KCl). Wash the residue on the filter with KCl solution till all the copper is removed, then with hot dilute HCl (1 in 50), finally with hot water. Separate the silica as before, ignite, and weigh. If the copper obstinately adheres to the paper, as sometimes happens, slip over the tube of the funnel a piece of india-rubber tubing with clip (or plugged with glass rod), fill up funnel with strong liquid ammonia, cover, and allow to remain for half-an-hour, then proceed with dilute acid, &c., as before.

The results of both processes agree with Fresenius's galvanic method.

Analytical Laboratory and Assay Office,
The Grove, Worcester.
February 14, 1881.

ARÄOMETRIC METHOD FOR THE ESTIMATION OF FAT IN MILK.

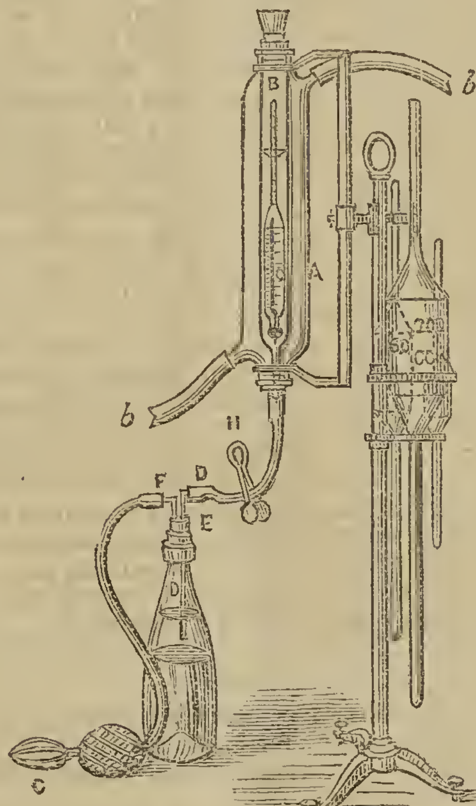
By Dr. F. SOXHLET,
Professor in the Technical High School, and Director of the Royal Agricultural Experimental Station, Munich.

For the estimation of the most important constituent of milk, the fat, only one method has proved satisfactory, namely, the gravimetric method. The numerous methods which have been proposed to substitute circumstantial methods, and those which can only be performed by a practical chemist, are erroneous in principle, and have, therefore, little claim for accuracy. The best of those which do not claim more than relative usefulness, is that of Tollens and Schmidt (*Journal für Landwirtshchaft*, 1878, 361), which consists of an improvement of Marchand's lacto-butyrometer. However, as regards accuracy, much still remains to be desired; for, even according to the experiments made by Prof. Tollens himself, the results obtained from the same sample of warm milk differed by 0·3 per cent, and of milk after standing by 0·56 per cent, that is, a difference of 10 and 16 per cent in the amount of fat calculated to 100. In the examination of milk for the detection of adulteration, a difference of 0·3 per cent is of importance; and it is not less so in the calculations for a large dairy, as 0·3 per cent fat is equal to 10 per cent butter. Thus the problem to replace the gravimetric method by a process equally correct, and which could be used without the use of the balance, and other analytical apparatus, has not been solved by Tollens and Schmidt, and thus the examination of milk had always to be made by a chemist. The new method, which I shall now describe, is scarcely more circumstantial, or more difficult to execute, than that of Tollens and Schmidt, and gives, as will be shown, quite as satisfactory and accurate results as those obtained by the gravimetric method.

The principle of my method does not occur in any of those in use. It consists as follows:—A known quantity of milk, caustic potash solution, and ether are shaken together; the fat, as is known, dissolves completely in the ether, which, after standing for a short time, rises to the surface. A small portion of the ether, which is always constant, remains dissolved in the alkaline solution, but does not contain any fat, as the ether in the water does not dissolve the slightest trace of fat. The remaining portion of ether forms with the fat a solution whose concentration varies as the amount of fat present in the milk. The concentration of this etherial solution of fat can be ascertained by the estimation of its specific gravity with as certain and accurate results as those obtained by estimating the amount of alcohol in an aqueous solution with the alcoholometer, as the difference between the specific gravity of fat and ether is as great as between that of water and alcohol.

I pass now to the description of the process, and shall give later the foundation and explanation of the manipulations.

Apparatus and Materials.—(1.) Apparatus for the determination of specific gravities, with three pipettes for measuring the milk, caustic potash solution, and ether respectively, and several bottles in which to agitate the mixtures. (2.) Caustic potash solution, of sp. gr. 1·26 to 1·27, prepared by dissolving 400 grms. fused caustic potash in a half litre of water, which after cooling is made up to one litre; or by dissolving 400 grms. caustic potash in 870 grms. water. (3.) Ether saturated with water. This is obtained by shaking commercial ether with one-tenth to two-tenths of its volume of water at the ordinary temperature. (4.) Commercial ether. (5.) A large vessel of at least 4 litres capacity, filled with water at a temperature of 17° to 18° C. When several estimations are to be made at the same time the vessel must be larger. When the temperature of the room is warmer, the temperature of the water should at first be 17°, when cooler 18° C.



Manner of Procedure.—The milk being thoroughly mixed, and at a temperature of 17·5° C., 200 c.c. are measured by the largest pipette and discharged into one of the bottles for agitating, which should have a capacity of 300 c.c. In the same manner 10 c.c. of the potash solution are measured, discharged into the bottle containing the milk, and mixed; 60 c.c. ether saturated with water are then added. The ether, when measured, must be between 16·5° and 18·5° C. The bottle is now closed with a cork or india-rubber stopper, shaken violently for

TABLE I.

Showing the amount of fat in weight per cent, corresponding to the sp. gr. of the etherial solution at 17·5° C.

Sp. Gr.	Fat p.c.	Sp. Gr.	Fat p.c.	Sp. Gr.	Fat p.c.	Sp. Gr.	Fat p.c.	Sp. Gr.	Fat p.c.	Sp. Gr.	Fat p.c.
43	2·07	47	2·52	51	3·00	55	3·49	59	4·03	63	4·63
43·1	2·08	47·1	2·54	51·1	3·01	55·1	3·51	59·1	4·04	63·1	4·64
43·2	2·09	47·2	2·55	51·2	3·03	55·2	3·52	59·2	4·06	63·2	4·66
43·3	2·10	47·3	2·56	51·3	3·04	55·3	3·53	59·3	4·07	63·3	4·67
43·4	2·11	47·4	2·57	51·4	3·05	55·4	3·55	59·4	4·09	63·4	4·69
43·5	2·12	47·5	2·58	51·5	3·06	55·5	3·56	59·5	4·11	63·5	4·70
43·6	2·13	47·6	2·60	51·6	3·08	55·6	3·57	59·6	4·12	63·6	4·71
43·7	2·14	47·7	2·61	51·7	3·09	55·7	3·59	59·7	4·14	63·7	4·73
43·8	2·16	47·8	2·62	51·8	3·10	55·8	3·60	59·8	4·15	63·8	4·75
43·9	2·17	47·9	2·63	51·9	3·11	55·9	3·61	59·9	4·16	63·9	4·77
44	2·18	48	2·64	52	3·12	56	3·63	60	4·18	64	4·79
44·1	2·19	48·1	2·66	52·1	3·14	56·1	3·64	60·1	4·19	64·1	4·80
44·2	2·20	48·2	2·67	52·2	3·15	56·2	3·65	60·2	4·20	64·2	4·82
44·3	2·22	48·3	2·68	52·3	3·16	56·3	3·67	60·3	4·21	64·3	4·84
44·4	2·23	48·4	2·70	52·4	3·17	56·4	3·68	60·4	4·23	64·4	4·85
44·5	2·24	48·5	2·71	52·5	3·18	56·5	3·69	60·5	4·24	64·5	4·87
44·6	2·25	48·6	2·72	52·6	3·20	56·6	3·71	60·6	4·26	64·6	4·88
44·7	2·26	48·7	2·73	52·7	3·21	56·7	3·72	60·7	4·27	64·7	4·90
44·8	2·27	48·8	2·74	52·8	3·22	56·8	3·73	60·8	4·29	64·8	4·92
44·9	2·28	48·9	2·75	52·9	3·23	56·9	3·74	60·9	4·30	64·9	4·93
45	2·30	49	2·76	53	3·25	57	3·75	61	4·32	65	4·95
45·1	2·31	49·1	2·77	53·1	3·26	57·1	3·76	61·1	4·33	65·1	4·97
45·2	2·32	49·2	2·78	53·2	3·27	57·2	3·78	61·2	4·35	65·2	4·98
45·3	2·33	49·3	2·79	53·3	3·28	57·3	3·80	61·3	4·36	65·3	5·00
45·4	2·34	49·4	2·80	53·4	3·29	57·4	4·81	61·4	4·37	65·4	5·02
45·5	2·35	49·5	2·81	53·5	3·30	57·5	4·82	61·5	4·39	65·5	5·04
45·6	2·36	49·6	2·83	53·6	3·31	57·6	4·84	61·6	4·40	65·6	5·05
45·7	2·37	49·7	2·84	53·7	3·33	57·7	4·85	61·7	4·42	65·7	5·07
45·8	2·38	49·8	2·86	53·8	3·34	57·8	3·87	61·8	4·44	65·8	5·09
45·9	2·39	49·9	2·87	53·9	3·35	57·9	3·88	61·9	4·46	65·9	5·11
46	2·40	50	2·88	54	3·37	58	3·90	62	4·47	66	5·12
46·1	2·42	50·1	2·90	54·1	3·38	58·1	3·91	62·1	4·48		
46·2	2·43	50·2	2·91	54·2	3·39	58·2	3·92	62·2	4·50		
46·3	2·44	50·3	2·92	54·3	3·40	58·3	3·93	62·3	4·52		
46·4	2·45	50·4	2·93	54·4	3·41	58·4	3·95	62·4	4·53		
46·5	2·46	50·5	2·94	54·5	3·43	58·5	3·96	62·5	4·55		
46·6	2·47	50·6	2·96	54·6	3·45	58·6	3·98	62·6	4·56		
46·7	2·49	50·7	2·97	54·7	3·46	58·7	3·99	62·7	4·58		
46·8	2·50	50·8	2·98	54·8	3·47	58·8	4·01	62·8	4·59		
46·9	2·51	50·9	2·99	54·9	3·48	58·9	4·02	62·9	4·61		

Note.—In the above table only the figures corresponding to the 2nd, 3rd, and 4th decimal places of those of the aräometer scale are given: *e.g*, the number 43·0 is equal to the sp. gr. 0·7430.

half a minute, placed in the water at 17·5° C., and shaken every alternate half minute for a quarter of an hour. After standing a quarter of an hour longer, a clear layer of the etherial solution of fat forms in the conical part of the bottle, the collection and purification of which is accelerated by giving to the contents of the bottle a gentle circular movement. It is indifferent whether the entire solution of fat, or only a portion, has collected, if there be sufficient to cause the aräometer to float. The etherial solution must be perfectly clear. With milk containing a large amount of fat (4½ to 5 per cent) the separation takes longer than a quarter of an hour; sometimes, but exceptionally, from one to two hours. In such cases, if the vessel containing the water is large enough, it is judicious to lay the well-closed bottle in a horizontal position in the water; the way for the ascending drops is thus considerably shortened, and the collection of ether hastened. When the bottle can again be placed in an upright position, the purification may be assisted by the gentle circular movement.

In order that the following manipulations may be understood, I shall now describe the apparatus for the estimation of the specific gravity of the etherial solution.

The stand has a holder fitted with a movable screw for holding the cooling tube A, to the tubes of which (*b.b.*) are attached two short india-rubber tubes. The holder of the tube A turns on its axle, so that A can be placed in a horizontal position. In the centre of A is fastened a smaller tube, B, whose diameter must be 2 m.m. greater than that of the float of the aräometer. At the lower end of B are fastened three small pieces of glass, to prevent the aräometer from adhering to the sides, while the upper end is closed by a cork. The scale of the aräometer, C, is divided into degrees from 66 to 40, corresponding to the specific gravities from 0·766 to 0·743 at 17·5° C.; these, again, are further divided by smaller and finer lines into halves. In the float of the aräometer is fastened a small thermometer, so graduated that $\frac{1}{10}$° C. may be read off. The drawn-out end of the tube B, which passes through the cork in the bottom of A, is connected by means of an india-rubber tube to the glass tube, D, which passes through the cork, E, of the agitating bottle. The glass tube, F, to which is attached the small hand-bellows, G, also passes through the cork. The stand also holds the three pipettes for measuring the milk, caustic potash solution, and ether.

The apparatus is now used as follows:—The india-rubber tube connected to the lower tube of A is placed in the vessel containing the water at 17° to 18° C. A is now filled with water by suction at B, and closed by connecting both ends (*b b*) with a glass tube. The stopper of the agitating bottle is now replaced by the cork E, and the tube D so inserted as to dip nearly to the bottom of the clear etherial solution. The cork at the top of A and the clamp H being opened, a quantity of ether, sufficient to cause the aräometer to float, is forced by means of a gentle pressure at G into the tube B. The clamp is now closed, and the cork inserted in B in order to prevent any evaporation of ether. After waiting from one to two minutes till compensation of temperature has taken place, the aräometer is brought as nearly as possible into the centre of the tube, and the position of the scale read off. That part of the scale is read off which coincides with the middle part of the deepest curved line on the surface of the liquid (meniscus). As the specific gravity is diminished by a higher and increased by a lower temperature, the temperature during the estimation of the specific gravity of the etherial solution must be noticed. Therefore shortly before or after ascertaining the position of the aräometer, the temperature of the liquid is obtained to within $\frac{1}{10}$° C. from the thermometer in the aräometer. If the temperature be exactly 17·5° C., the specific gravity will of course require no farther correction; in other cases, however, the specific gravity obtained by the aräometer can be easily calculated to that at the standard temperature, 17·5° C. For each degree Celsius over 17·5° C., one degree is added to, and for each degree under 17·5° C., one degree is subtracted from, the statement of the aräometer; *e.g.*, 58·9 degrees at 16·8° C., at standard temperature become 58·2; 47·6 degrees at 18·4° C., at standard temperature become 48·5. The temperature of the water in A may fluctuate between 16·5° and 18·5° C. The specific gravity of the etherial solution at 17·5° C. being found, the amount of fat in weight per cent is obtained directly from Table I.

After finishing the determination, in order to prepare the apparatus for a second, the cork of B and the clamp, H, are opened to permit the ether to flow back into the agitating bottle. B is now filled from the bottle with commercial ether, which is allowed to flow back again. The tube B, india-rubber tube, &c., are now thoroughly dried by forcing a current of air through the apparatus by means of a hand bellows, G. As the aräometer is apt to be injured by coming in contact with B, it is advisable, before forcing the air through, to turn the tubes A and C to a horizontal position.

The estimation of the specific gravity, including the preparation of the apparatus for another estimation, scarcely takes five minutes. From the description of the manner of cleaning the apparatus, it will be seen that there is little risk of the aräometer being injured, as it is never taken out of the tube B. Allowing half an hour for the mixing and separation of the etherial solution, an estimation of fat may be made in from forty to forty-five minutes; but five estimations can be made as easily in an hour, when they are carried on at the same time. The method, therefore, not only allows several estimations to be made at the same time, but is also very expeditious.

As a proof of the accuracy of the results obtained by this process, as well as the soundness of the principle on which it is based, the following control-experiments are given:—

The relation of the specific gravity of the etherial solution to the fat contained in the milk was established in the following manner. Fresh, still-warm milk was, by means of a small centrifugal machine, deprived of its cream in such a manner that a cream containing about 10 per cent fat was obtained. Some of this cream was then added to another portion of milk, in such quantity as to produce a milk containing nearly 5 per cent fat. Moreover, weighed quantities of the skim milk, obtained at the same time, were mixed with weighed quantities of fresh milk. As the amount of fat contained in the fresh and skim-milk had been carefully estimated by the gravimetric method, the exact amount in each of the different mixtures was known. The most satisfactory from this series of experiments formed the basis for the calculation of the table.

The rich milk used contained 4·95 per cent, the poor 0·20 per cent fat. The hydrometer used was compared on eight points of the scale with mixtures of alcohol and ether, whose specific gravities had been exactly determined with the piknometer to the fourth decimal place, and the ascertained values rectified according to the table of corrections.

TABLE II.

	Rich Milk. Grms.	Poor Milk. Grms.	Sp. Gr. of Mixture at 15° C.	Amount of Fat in Mixture in weight Per cent.	Decrease of the Amount of Fat.	Sp. Gr. of the Etherial Solution.	Decrease of the Sp. Gr.
1.	1000	—	1·0297	4·95	—	0·7650	—
2.	950	50	1·0300	4·71	0·24	0·7636	0·0014
3.	900	100	1·0303	4·48	0·23	0·7621	0·0015
4.	850	150	1·0307	4·24	0·24	0·7605	0·0016
5.	800	200	1·0311	4·01	0·23	0·7588	0·0017
6.	750	250	1·0312	3·76	0·24	0·7571	0·0017
7.	700	300	1·0315	3·53	0·23	0·7553	0·0018
8.	650	350	1·0317	3·29	0·24	0·7534	0·0019
9.	600	400	1·0320	3·05	0·24	0·7514	0·0020
10.	550	450	1·0322	2·81	0·24	0·7495	0·0019
11.	500	500	1·0327	2·58	0·23	0·7475	0·0020
12.	450	550	1·0330	2·34	0·24	0·7454	0·0021
13.	400	600	1·0332	2·10	0·24	0·7433	0·0021

TABLE III.

		Sp. gr. of the Milk at 15° C.	Aräometric.	Gravimetric.	Difference.
Milk of separate cows from a Munich dairy; grass-fed.	1.	1·0328	4·03	4·04	−0·01
	2.	1·0304	3·68	3·70	−0·02
	3.	1·0307	3·20	3·25	−0·05
	4.	1·0310	3·73	3·68	+0·05
	5.	1·0320	3·88	3·89	−0·01
	6.	1·0332	3·88	3·91	−0·03
	7.	1·0338	3·80	3·86	−0·06
	8.	1·0303	4·58	4·64	−0·06
	9.	1·0310	3·35	3·38	−0·03
	10.	1·0310	4·06	4·09	−0·03
	11.	1·0320	3·01	2·98	+0·03
	12.	1·0340	2·65	2·66	−0·01
	13.	1·0320	3·36	3·41	−0·05
	14.	1·0324	3·54	3·49	+0·05
	15.	1·0338	2·64	2·66	−0·02
	16.	1·0305	4·01	3·98	+0·03
Milk of the Munich Milk Company; samples of six different mixtures.	17.	1·0330	3·44	3·41	+0·03
	18.	1·0320	3·23	3·27	−0·04
	19.	1·0320	3·93	3·95	−0·02
	20.	1·0320	3·18	3·21	−0·03
	21.	1·0322	4·06	4·02	+0·04
	22.	1·0310	4·09	4·10	−0·01
Milk of single cows from a Munich dairy; fed with beer malt.	23.	1·0310	3·79	3·80	−0·01
	24.	1·0338	3·97	3·98	−0·01
	25.	1·0325	4·05	4·09	−0·04
	26.	1·0328	3·45	3·48	−0·03
	27.	1·0328	2·88	2·84	+0·04
	28.	1·0312	3·14	3·12	+0·02
	29.	1·0345	2·47	2·44	+0·03
	30.	1·0330	3·41	3·44	−0·03
	31.	1·0307	3·71	3·75	−0·04
Mixtures of rich and poor milk.	32.	1·0307	4·72	4·67	+0·05
	33.	1·0314	3·84	3·84	0·00
	34.	1·0320	3·23	3·18	+0·05
	35.	1·0330	2·81	2·78	+0·03
	36.	1·0312	3·64	3·64	0·00
No. 36 with 20 per cent water.	37.	1·0260	3·07	3·04	+0·03
Milk from Munich milk shops.	38.	1·0320	3·98	4·03	−0·05
	39.	1·0312	3·70	3·63	+0·07
	40.	1·0314	3·11	3·11	0·00
	41.	1·0322	3·53	3·53	0·00
	42.	1·0318	3·68	3·61	+0·07
	43.	1·0317	4·43	4·45	+0·02
No. 43 with 20 per cent water.	44.	1·0270	3·71	3·71	0·00
Milk of separate cows.	45.	1·0325	3·60	3·60	0·00
	46.	1·0327	3·89	3·94	−0·05
	47.	1·0320	3·63	3·60	+0·03
	48.	1·0335	3·68	3·75	−0·07
	49.	1·0320	4·36	4·32	+0·04
	50.	1·0330	3·81	3·84	−0·03
	51.	1·0320	4·24	4·21	+0·03
	52.	1·0330	4·02	3·98	+0·04

In order to test the exactness of the method, the fat of 52 samples of milk, obtained from various sources, was estimated both by the aräometric and gravimetric methods. The latter method consisted in drying a weighed quantity of milk in the water-bath with gypsum, and then extracting with ether till the weight was constant. Table III. shows the results obtained.

From this list, it appears that the greatest difference between the results obtained by both methods consists only of 0·07 per cent. As a difference of 0·05 per cent between the results obtained from two estimations of the same milk by the gravimetric process is considered satisfactory, it is justifiable to state that the aräometric method is as accurate as that of the former; at least, it can be said to give the amount of fat within 0·1 per cent. The results show, further, that the method is applicable for the examination of milk of different origin and qualities. Among the samples of milk examined were those of mixed and re-mixed milk, of milk of cows fed on grass and beer-malt, of milk obtained from various dairies, and of milk mixed with 20 per cent water. Sample No. 44, which was purposely mixed with 20 per cent water, is worthy of special attention, as an example by which the genuineness of milk may be ascertained. The amount of fat (3·7 per cent) is equal to that of genuine milk, but the specific gravity is lower. The relation between the specific gravity and the amount of fat shows, in spite of the quantity of fat, that water had been added to the milk; a fact which proves that the estimation of fat, or of any other single constituent of milk, is insufficient for testing the genuineness of it. A similar relation is also shown by sample No. 37.

Besides these experiments with cows' milk, three samples of goats' milk were also examined.

	Aräometric.	Gravimetric.	Difference.
1.	5·27	5·15	+0·12
2.	2·70	2·60	+0·10
3.	3·26	3·30	+0·04

The differences here are a little greater than those already given, owing, perhaps, to the nature of the fat of goats' milk differing from that of cows' milk.

(To be continued.)

LONDON WATER SUPPLY.

Report on the Composition and Quality of Daily Samples of the Water Supplied to London, from January 20th to February 19th, 1881.

By WILLIAM CROOKES, F.R.S.,
WILLIAM ODLING, M.B., F.R.S., F.R.C.P.,
Professor of Chemistry at the University of Oxford;
and C. MEYMOTT TIDY, M.B., F.C.S.,
Professor of Chemistry and of Forensic Medicine at the London Hospital; Medical Officer of Health for Islington

To the Right Honourable the President of the Local Government Board.

February 21, 1881.

Sir,—We submit to you the results of our examinations of the water supplied to the Metropolis for the month ending February 19th.

These examinations have been made under instructions from the Water Companies, the selection of samples, the methods of analysis, and the form of publication have been left entirely to us, the Companies themselves taking no part in the matter beyond bearing the expenses.

It will be seen that the regularity of our work has been somewhat interfered with by the exceptional weather through which we have passed.

The turbidity (which we have duly recorded) of many of the waters may be accounted for, at any rate in part, by unavoidable conditions consequent on the severe frost. It is not improbable that it will still be some days before the waters regain their usual condition of clearness. The suspended matter is almost entirely of the nature of clay and sand, and on the worst days did not average more than one grain per gallon.

In Table I. we have recorded the analyses in detail of samples, one taken daily between Jan. 20th and Feb. 19th. The purity of the water in respect of organic matter, has been determined by the oxygen and the combustion processes, and the results of our analyses by these methods are stated in columns XIV. to XVIII.

In Table II. is recorded the colour, together with the clearness or turbidity of each sample. Of the 157 samples collected by us between the dates mentioned above, 91 were found "*clear*," 23 were noted as "*very slightly turbid*," 31 as "*slightly turbid*," and 12 as "*turbid*."

Of the 24 samples supplied by the New River Company, 2 were noted as "very slightly turbid," the remainder being clear, bright, and efficiently filtered.

Of the 18 samples from the mains of the East London Company, 6 were noted as "very slightly turbid," and 4 as "slightly turbid." The remainder were, bright, clear, and well filtered.

Of the 25 samples from the mains of the Chelsea Water Company, 5 were noted as "very slightly turbid." The remainder were bright, clear, and well filtered.

Of the 18 samples from the mains of the West Middlesex Company, 4 were noted as "slightly turbid," and 2 as "very slightly turbid." The remainder were clear, bright, and well filtered.

Of the 25 samples from the mains of the Lambeth Water Company, 1 was noted as "very slightly turbid," 7 as "slightly turbid," and 5 as "turbid." The remainder were clear, bright, and well filtered.

Of the 26 samples from the mains of the Grand Junction Company, 11 were noted as "slightly turbid," and 3 as "turbid." The remainder were clear, bright, and well filtered.

Of the 21 samples from the mains of the Southwark and Vauxhall Company, 7 were noted as "very slightly turbid," 5 as "slightly turbid," and 4 as "turbid." The remainder were clear, bright, and efficiently filtered.

If a trace of suspended matter be noticeable, we record the water as "turbid." If on close scrutiny we are able to detect any suspended matter whatever, we call the water "very slightly turbid." A water is recorded as "slightly turbid" when we consider it to come between those two extremes.

In Table III. we have recorded the quantities of free oxygen in the 155 samples.

Lastly, we are of opinion that, although many of the samples examined by us, as we have stated, were more or less turbid from finely-suspended clay and sand, nevertheless the water supplied during the past month was wholesome, of good quality, and well oxygenated.—We remain, Sir, your faithful servants,

William Crookes,
William Odling,
C. Meymott Tidy.

PROCEEDINGS OF SOCIETIES.

PHYSICAL SOCIETY.

Saturday, February 26, 1881.

Prof. Fuller in the Chair.

The former resolution regarding the moneys of the Society for investment was adopted.

Dr. O. J. Lodge exhibited a hydro-mechanical apparatus illustrating the fact that conductors of electricity are opaque to light, and showed by means of a Wheatstone's photometer, which combines wo circular motions into a harmonic one, how the plane of polarisation of a beam of light passing through a magnetic medium is rotated.

Mr. C. V. BOYS exhibited his new integrating machine, which is the only one illustrative of the mathematical process of integration, and is therefore specially valuable for teaching purposes.

Mr. SHELFORD BIDWELL read a paper on the "*Telegraphic Transmission of Pictures of Natural Objects.*" The process is explained as follows:—The positive pole of a battery is connected through a set of resistance-coils to a piece of platinum wire, and the negative pole to a plate of zinc, upon which is placed a sheet of paper moistened with a solution of potassium iodide. The negative pole of a second battery is connected through a selenium cell with the same platinum wire and the positive pole to the zinc plate. The point of the platinum wire is pressed upon the paper, and the selenium being exposed to a strong light, the variable resistance is so adjusted that the currents from the two batteries, which pass through the paper in opposite directions, exactly neutralise each other. The platinum point will now make no mark when drawn over the paper, but if the selenium is shaded its resistance is immediately increased: the current from the first battery then predominates, and the path of the platinum point across the paper is marked by a brown line, due to the liberation of iodine. The line is fainter the feebler the light is. This arrangement has been applied by Mr. Bidwell in his "Telephotograph," exhibited to the meeting. The transmitter consists of a brass cylinder mounted on a screw spindle, which carries the cylinder laterally 1-64th inch at each revolution. A pin-hole in the middle of the cylinder allows light to fall upon a selenium cell placed behind it within the hollow cylinder. The cell is connected in circuit with a battery and the line. The receiver consists of a similar metal cylinder, mounted so as to rotate synchronously with the first, and having a platinum point pressing upon a sheet of chemical paper wrapped round the cylinder. This receiver and transmitter are connected up as described above with two batteries and a set of resistance coils. The image to be transmitted is focussed upon the cylinder of the transmitter, and the resistance adjusted, and the receiving cylinder covered with sensitised paper. The two cylinders are caused to rotate synchronously, the pinhole in the course of its spiral path covering successively every poiut of the focussed picture. The amount of light falling upon the selenium will be proportional to the illumination of that particular spot of the projected image which is for the time being occupied by the pinhole, and the intensity of the line traced by the platinum point in the receiver will vary in the same proportion. These variations will produce a picture which, if the instrument were perfect, would be a counterpart of that projected upon the transmitter. Simple designs cut of tinfoil and projected by a line have been successfully transmitted. With selenium and paper of greater sensitiveness more perfect results might undoubtedly be obtained.

Professors AYRTON and PERRY showed an experiment illustrating their plan for sending light and shade images by electricity. A selenium cell was connected in circuit with a battery and a coil of wire surrounding a tube along which a beam of light passed. A shutter having a small magnet attached was suspended in the tube like a galvanometer mirror, so that when a current traversed the coils the shutter was deflected so as to close, or partially close, the tube and shut off the beam of light. It will be understood that when a ray of light fell on the cell, and diminished the resistance, the current in the coils would increase to a degree proportional to the intensity of the ray, and thus the shutter would proportionally cut off the light in the receiver. If, now, a number of these elementary circuits were combined so as to provide a mosaic of cells to transmit the reflected image of an object, and a screen to receive the corresponding beams of light controlled by the shutters at the other end of the line, there would be a means of sending light and shade images by wire. A rapidly rotating arm, carrying a row of cells upon it, might answer for a stationary mosaic transmitter, and need fewer cells, while a Japanese mirror, having its curvature altered by electromagnets behind, might be made to act as a receiver, the "magic" images of that mirror being due to inequalities of curvature.

Prof. AYRTON agreed with Mr. Bidwell in his concusion that selenium cells of high resistance were more sensitive to light than cells of low resistance.

Dr. COFFIN suggested that Mr. Bidwell should adopt other than the cylindrical forms of receiver, and move an image of the object across the pinhole.

Prof. G. C. FOSTER advised bringing the light always on one and the same part of the selenium cell.

CORRESPONDENCE.

PURIFICATION OF SEWAGE.

To the Editor of the Chemical News.

SIR,—In regard to Mr. Spence's patent process for the treatment of sewage referred to in my paper on "Sewage Precipitation," I wish to state that Mr. Spence does not propose, on the large scale, to distil the precipitated albumin for the purpose of producing ammonia, but intends to use it in its crude condition as a constituent of artificial manure. I consider it right to add that Mr. Spence is well pleased with the practical trials he has made with Birmingham sewage.—I am, &c.,

WM. WALLACE.

City Analysts' Laboratory,
138, Bath Street, Glasgow,
March 1, 1880.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, l'Académie des Sciences. No. 6, February 7, 1881.

Thermic Formation of the Pyrogenous Carbides.—M. Berthelot.—Each molecule of acetylene combined in the formation of pyrogenous carbides evolves a quantity of heat approaching that produced by the union of oxygen with hydrogen to form gaseous water.

Remarks on the Characters of the Organic Chlorinised Gases and Vapours.—M. Berthelot.—The presence of volatile chlorine compounds, like chloroform, dissolved in the blood or in organic liquids, may be shown by passing their vapour mixed with air and watery vapour through a tube heated to redness. The chlorine is partly set free and partly converted into hydrochloric acid. The gases are passed into a solution of silver nitrate, and furnish a characteristic white precipitate. The action of the electric spark and that of combustion equally decompose organic chlorinated gases, and make them capable of precipitating silver nitrate. The author, however, has observed certain causes of error in such researches, due to the presence of hydrocyanic acid and of acetylene. The presence of hydrocyanic acid frustrates, in fact, the detection of chlorine and hydrochloric acid, because silver cyanide is formed even in solutions strongly acidified with nitric acid. Acetylene also forms a precipitate of silver acetylide in neutral and even in slightly acid solutions. Silver acetylide dissolves in concentrated boiling nitric acid, and the liquid remains clear on subsequent dilution with water. In case of hydrocyanic acid the gases should be received at first in pure water, which is then boiled for some time to expel the hydrocyanic acid. Hydrochloric acid, on the contrary, remains in the liquid, since it forms a hydrate less volatile than pure water.

Double Elliptical Refraction and the Three Systems of Fringes.—M. Crouillebois.—It is established that the inverse and reciprocal rays have a real existence independent of the quartz.

A New Apparatus intended to show the Dissociation of Ammoniacal Salts.—D. Tommasi.—The author describes an apparatus which he names the dissocioscope, and which serves to exhibit at a lecture the dissociation of the ammoniacal salts.

The Derivatives of Acroleine.—E. Grimaux aud P. Adam.—The authors give an account of meta-croleine, which they obtain by the method of Geuther and Cartmell.

Action of Hydrochloric Acid upon Aldehyd.—M. Hanriot.—A continuation of the researches of Lieben (*Comptes Rendus*, xlvi., 662).

Bulletin de la Société Chimique de Paris,
Nos. 4 and 5, Sept. 5, 1880.

Application of Dialysing Apparatus for the Extraction of Iodine from the Juices of Sea-Weed.—J. Pellieux and E. Allary.—The weeds which have yielded their juice are introduced into the Pellieux incinerator, where they burn and their ashes are melted. The juice is introduced into the Porion evaporator or into contact with the hot gases of the incinerator, and are concentrated, whilst the decomposed products are retained in this incinerator. These juices, concentrated to 32° to 40° B., are conveyed to the central refinery, where they are treated in Dubrunfaut's osmogen, and thus transformed into crystalline liquids, suitable for the extraction of iodine without the necessity for calcination. The process of osmosis should be effected in heat, when it goes on ten times more rapidly than in the cold. Some years ago a pharmacist of Brest, M. Herland, proposed, under the name of "Osmotic Treatment of Sea-weeds," the following process for the extraction of iodine with the object of completely superseding incineration. The recent weeds were steeped in lime-water in which the iodides became dissolved by diffusion. The solution was then submitted to evaporation, to obtain the iodine from the concentrated mother-liquors. This process was impracticable on the large scale, and was abandoned by its author.

The Reactions of Antimony Chloride and Carbon Disulphide.—Armand Bertrand and E. Finot.—If these bodies are brought in contact in a refrigerated flask there are formed crystals of antimony sulpho-chloride. If the reaction takes place at a gentle heat the products are, as indicated by Klein, antimony trichloride, sulphur, and carbon tetra-chloride.

Studies of the Reactions Produced between Free Oxygen and Bromated Molecules where the Carbons are United by several Bonds.—E. Demole.—Not suitable for abstraction.

Action of the Chlorides of the Sulpho-conjugated Acids upon Urea.—S. U. Elander.—If 1 mol. phenylsulphurous chloride is allowed to react upon 2 to 3 mols. of urea at the temperature of the water-bath, hydrochloric acid is evolved, and a very complex body is obtained, to which the author assigns the formula—

$$C_6H_5.SO.N_4H_5.C_2O_2+H_2O.$$

Combination of Chloral Hydrate and Camphor.—MM. P. Cazeneuve and Imbert.—Already noticed.

Pyridic Bases.—W. Oechsner de Coninck.—An account of certain derivatives of lutidine and collidine.

Ultimate Action of Bromine upon Malonic Acid: Bromoform.—E. Bourgoin.—Not suitable for abstraction.

Sorbine and Sorbite.—C. Vincent.—In two successive operations conducted according to the directions of Pelouze, the author obtained, the first time, sorbin, the second, merely sorbite. The latter body is isomeric with dulcite and mannite, and behaves like them in contact with oxalic acid.

Russian Chemical Society.—Session Nov. 1/12, 1879.—M. Kutcheroff finds that no solid fatty acids are formed on the oxidation of cholalic acid by M. Tappeiner's process.

M. Wilm proves that the substances (lime, silica, &c.) which cause an absorption of oxygen during the calcination of chromium sesquioxide are furnished from the sides of the vessel in which the operation is carried on.

M. Kapoustine indicates a process which permits a rapid determination of the carbonic acid of the air with very sufficient exactness.

M. Potilitzine communicated two important papers which will be inserted at some length.

Reimann's Färber Zeitung,
No. 37, 1880.

Wool-dyeing is now carried on with energy in Japan, and six silk-dyers have been sent from Lyon to arrange a silk-dyeing establishment at Yeddo on European principles.

Orchil paste and liquor and cudbear are now manufactured in California.

The sumac of New Brunswick is said to be equal to the best Sicilian sorts.

No. 39, 1880.

Artificial Indigo.—The nitro-product required for the production of artificial indigo can be easily obtained from cinnamic acid, or directly by the application of a substituted benzal-chloride.

At Mülhouse ceruleine is now in almost exclusive use for greens, and methylen-blue for blues, whilst Geigy's indigo-substitute is being carefully tried for dark grounds. At the chemical school Dr. Noelting lectures on general chemistry in the first year of the course, and on the aromatic compounds, the colouring-matters, dyeing, and printing in the second year, six hours weekly being devoted to each course. De la Harpe teaches physics and analytical chemistry, and Dr. O. N. Witt industrial chemistry

MISCELLANEOUS.

The Chemical Laboratory of Wiesbaden.—The Chemical Laboratory at this place still enjoys a very large attendance. Besides the Directors, Geh. Hofrath and Prof. R. Fresenius, there are engaged as teachers in the establishment, Dr. H. Fresenius, Dr. E. Borgmann, Dr. W. Fresenius, Oberlehrer F. Henrich, and Architect Brahm. The Assistants in the Laboratory, in the Summer Term 1880, were twelve in number, and in the Versuchsstation four. In the present term, there are twelve engaged in the Laboratory and two in the Versuchsstation. In the Summer Term 1880, there were 61 students on the books; of these 39 were from Germany, 5 from England, 4 from Switzerland, 3 from Russia, 3 from North America, 2 from Austro-Hungary, 2 from Belgium, 2 from Sweden, and 1 from France. In the present Term there are 64 students; of these, 46 are from Germany, 4 from England, 3 from Switzerland, 3 from Sweden, 2 from Austro-Hungary, 2 from Belgium, 2 from North America, 1 from Russia, and 1 from South America. During the above mentioned time, numerous scientific researches were carried on in the Laboratory and the Versuchsstation, and a great number of analyses were undertaken on behalf of Manufacture, Trade, Mining, and Agriculture.

NOTES AND QUERIES.

⁂ Our Notes and Queries column was opened for the purpose of giving and obtaining information likely to be of use to our readers generally. We cannot undertake to let this column be the means of transmitting merely private information, or such trade notices as should legitimately come in the advertising columns.

Bleaching-powder.—Mr. Kingzett writes to say that during the past week he has succeeded in making a quantity of calcic hypochlorite from a fresh sample of bleaching-powder and without any difficulty whatever, by repeating his process already published in the Chemical News.

Aniline Black Marking Ink.—We are anxious to procure a recipe for an aniline black for marking collars and similar goods, which would be thoroughly reliable. It should be permanent, easy of application, not destructive to linen or cotton cloth, capable of keeping good a reasonable time, and always the same in strength and effects. We have tried several makes, but, as a rule, find them variable in the above points.—G. B.

MEETINGS FOR THE WEEK.

Monday, 7th.—London Institution, 5.
—— Medical, 8.30.
—— Royal Institution. General Monthly Meeting, 5.
—— Society of Arts, 8. "The Scientific Principles Involved in Electric Lighting," Professor W. G. Adams, F.R.S.
Tuesday, 8th.—Royal Institution, 3 p.m. "The Blood," Prof. Schäfer.
—— Civil Engineers, 8.
—— Medical and Chirurgical, 8.30.
—— Medical. Anniversary, 8.30.
Wednesday, 9th.—Society of Arts, 8. (In the Theatre of the South Kensington Museum) "Ascents of Chimborazo and Cotopaxi, in 1880," Mr. Edward Whymper.
—— Geological, 8.
—— Microscopical, 8.
Thursday, 10th.—London Institution, 7.
—— Royal, 4.30.
—— Royal Society Club, 6.30.
—— Mathematical, 8.
—— Royal Institution, 3. "Cuneiform Characters," Rev. W. Houghton.
Friday, 11th.—Royal Institution, 8. "Language and Literature of the Scottish Highlands," Prof. J. S. Blackie, 9.
—— Quekett, 8.
Saturday, 12th.—Royal Institution, 3. "Ancient Egypt," Mr. R. S. Poole.
—— Physical, 3. "On the Absorption Spectra of Organic Bodies," Col. Festing and Capt. Abney.

TO CORRESPONDENTS.

J. Hemingway.—Wagner's "Technology," published by Churchill; Richardson and Watts's "Chemical Technology," published by Baillière.

In fcp. 8vo., with 50 Woodcuts, price 1s. 6d. cloth,

EXPERIMENTAL CHEMISTRY FOR JUNIOR STUDENTS. By J. Emerson Reynolds, M.D., F.R.S., Professor of Chemistry, University of Dublin. Part I. *Introductory.*

"Dr. Reynolds' little manual is an excellent example of the experimental method applied to teaching, and is admirably adapted as a text-book for the use of the lower science classes in schools."—*Chemists' Journal.*

London: LONGMANS and CO.

PROF. ODLING'S CHEMISTRY FOR MEDICAL STUDENTS.

Now ready, a New Edition, Illustrated with 71 Woodcuts of Microscopical Preparations and Chemical Apparatus, price 6s.

A COURSE of PRACTICAL CHEMISTRY, arranged for the use of Medical Students, with express reference to the *Three Months' Summer Practice.* By William Odling, M.A., F.R.S., Professor of Chemistry in the University of Oxford. Fifth Edition, thoroughly revised.

London: LONGMANS and CO.

ROYAL POLYTECHNIC.—The Photophone, popularly explained and illustrated by experiments. The Great Lightning Inductorium; a Popular Astronomical Lecture, illustrated by beautiful Dissolving Views and Effects, &c., by Mr. J. L. King. Musical Sketches of a high and amusing order, by Mr. Eric Lewis. Magical Art in Perfection, by Prof. R. Hellis. Costume Recitals, by Madame Katharine Hickson. Electric Railway. Leotard and Blondin, the Wonderful Automata. Diving Bell, &c. Admission to the whole, 1s. Open from 12 till 5, and from 7 till 10.

Recently published, price 6s.

A TREATISE ON FUEL: Scientific and Practical. By ROBERT GALLOWAY, M.R.I.A., &c. The best methods of estimating the heating power of fuels, and the technical examination and analysis of the different varieties of coal are fully described; and among the illustrations, drawn to scale, are Siemens's Regenerative Gas Furnace, Pyrometer, &c., with complete descriptions.

By the same Author,

In the Press, and will be published immediately,

EDUCATION, SCIENTIFIC and TECHNICAL; or, HOW THE INDUCTION SCIENCES ARE TAUGHT; and HOW THEY OUGHT TO BE TAUGHT.

London: TRÜBNER and CO., Ludgate Hill.

SOLAR PHYSICS.

The following Courses of Lectures will be given by Members of the Committee on Solar Physics, appointed by the Lords of the Committee of Council on Education:—

An Introductory Lecture. By Professor Stokes, Sec. R.S. 6th April, 1881.

A Lecture on the Practical Importance of Studying the Influence of the Sun on Terrestrial Phenomena. By Lieut.-General Strachey, R.E., C.S.I., F.R.S. 8th April.

Two Lectures on the Connection between Solar and Terrestrial Phenomena. By Professor Balfour Stewart, F.R.S. 27th and 29th April.

Six Lectures on Spectroscopy in Relation to Solar Chemistry. By Mr. J. Norman Lockyer, F.R.S. 4th, 6th, 11th, 13th, 18th, and 20th May.

Three Lectures on the Photography of the Infra-red of the Spectrum in its Application to Solar Physics. By Captain Abney, R.E., F.R.S. 25th and 27th May and 1st June.

The Lectures will be delivered in the Lecture Theatre of the South Kensington Museum, at 4 p.m., on the days stated above.

Admission will be by Tickets, which may be obtained, as far as there is room, on application by letter to the Secretary, Science and Art Department, South Kensington, S.W.

BERNERS COLLEGE of CHEMISTRY.

Instruction and preparation in CHEMISTRY and the EXPERIMENTAL SCIENCES under the direction of Professor E. V. GARDNER, F.A.S., M.S.A.

The Class Rooms are open from 11 to 5 a.m. and from 7 to 10 p.m daily.

Especial facilities for persons preparing for Government and other examinations.

Private Pupils will find every convenience.

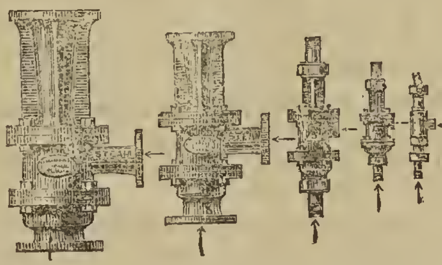
Analyses, Assays, and Practical Investigations connected with Patents, &c., conducted.

Prospectuses and full particulars on application to Prof Gardner at Berners College, 44, Berners-street W.

BAILEY'S LOW LIFT STEAM JET PUMPS, (HALLAM'S PATENT)

For Lifting Water from Wells, Steam Ships, Tanks, Rivers, Reservoirs, &c.

The three smaller ones are all Gun Metal.



Cast Iron with Gun metal Fittings.

Prices for Heights of not more than 40 ft., at 30 lbs. Pressure.

Please note these when ordering,	6	5	4	3	2	1	0	0A
Bore of Water Delivery Pipe in inches	4	3	2	1½	1	¾	½	½
Bore of Steam Pipe	2½	1½	1¼	1	¾	½	⅜	¼
Delivery in gals. per hour at 30 lbs. prssre.	8000	5000	2500	1500	800	500	200	100
Price .. £	20 0	12½	10 0	7 10	4 10	3 3	2 2	1 10

W. H. BAILEY and CO., Engineers, &c.,
ALBION WORKS, SALFORD, MANCHESTER.

AMMONIACAL LIQUOR.

THE DIRECTORS OF THE BRISTOL UNITED GAS LIGHT COMPANY invite TENDERS for the PURCHASE of the AMMONIACAL LIQUOR made at all or either of their THREE STATIONS, situate respectively at AVON STREET, CANONS' MARSH, and STAPLETON ROAD in the Borough of Bristol, for a TERM of FIVE or SEVEN YEARS, commencing on 1st JULY, 1882.

The Annual Quantity of Liquor produced at present at the three Stations is about 2½ millions of gallons.

Conditions of Contract and other particulars may be obtained of e SECRETARY, at the Office of the Company, Canon's Marsh, Bristol.

Tenders to be delivered on or before TUESDAY, 3rd day of May next, addressed to the Chairman of the Company, and marked 'Tender for Ammoniacal Liquor."

The Directors do not bind themselves to accept the highest or any Tender.

HENRY H. TOWNSEND, Secretary.

Gas Offices, Canons' Marsh, Bristol,
8th January, 1881.

MR. J. S. MERRY,
ASSAYER AND ANALYTICAL CHEMIST,
SWANSEA.

SPECIALITIES.

MANGANESE—Finest Crystallised, Lump, Ground, and Granulated of every quality, and PREPARED for *Chlorine, Glass, Steel, Ferro-Manganese Pottery, Battery*, and EVERY PURPOSE.

BAUXITE—(Hydrate of Alumina) Of high percentage of Alumina and almost free from Iron. The CHEAPEST, BEST, and MOST PROFITABLE article from which to produce ALUM, ALUM CAKE, and SULPHATE OF ALUMINA, &c. [BRAND, "IRISH HILL BAUXITE."]

FLUOR-SPAR—Of the Very Finest Quality for Acid, Soda, Glass Flux, and all purposes

BARYTES—(Carbonate and Sulphate. Crystallised, Selected Lump and Ground for all uses.

CRYOLITE—Magnesite, Felspar, Arsenic, Phosphates, French Chalk, Strontia, Wolfram, Chrome, Terra Alba, Rotten Stone, China Clay, Umbers Ochres, Antimony, Calamine, Emery Stone all Oxides, and all

FULLER'S EARTH—Of superior quality, and entirely free from grit. [BRAND, "EMERALD."]

MINERALS, CHEMICALS, AND COLOURS.

GEO. G. BLACKWELL,
MINE PROPRIETOR,
Manganese and Mineral Works, Grinding Mills, and Ore Yards, GARSTON.

OFFICES—26 CHAPEL STREET LIVERPOOL.

WILLIAM AND WILLIAM T. FIELD,

MANUFACTURERS of the Celebrated STAFFORDSHIRE BLUE BRICKS, specially adapted for Chemical Plant, *i.e.*, Acid Towers, &c. Also all other kinds of Best Staffordshire Blue Bricks, Pavings, Plynths, Splays, Copings, &c. &c. Prices and samples on Application.

TESTIMONIAL

"We have used the Blue Staffordshire Brick or Sulphuric Acid Towers, &c., manufactured by Messrs. Field, for the last fifteen years during which time they have given great satisfaction. We recommend them to the Chemical Trade, believing there is nothing better in the market."—(Signed) WILLIAM HUNT and SONS, Lea Brook Alkali Works, near Wednesbury, Staffordshire, February, 1878.

TOLL END BRICK-WORKS,
TIPTON, STAFFORDSHIRE.

Water-Glass, or Soluble Silicates of Soda and Potash, in large or small quantities, and either solid or in solution, at ROBERT RUMNEY'S Ardwick Chemical Works, Manchester.

Wanted, to Purchase Volumes 1, 3, 5, 6, and 7, of the 'Journal of the Chemical Society"; also Vol. 3 of the "Proceedings of the Royal Society."—Address, K. P. G., CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.

THE CHEMICAL NEWS
AND
JOURNAL OF PHYSICAL SCIENCE.

Edited by WILLIAM CROOKES, F.R.S.

Published every Friday. Price 4d. Annual Subscription, post free including Indices, £1

CHARGES FOR ADVERTISEMENTS.

	£	s.	d.
Five lines in column (about 10 words to line)	0	3	6
Each additional line	0	0	6
Whole column	1	15	0
Whole page	3	0	0

A reduction made for a series of insertions.

Cheques and Post-Office Orders, crossed "London and County Bank," payable to the order of William Crookes.

BOY COURT LUDGATE HILL LONDON, E.C

ESTABLISHED 1798.

ROBERT DAGLISH & CO.,
ENGINEERS, BOILER AND BRIDGE MAKERS, MILLWRIGHTS,
BRASS AND IRON FOUNDERS.

Manufacturers of every description of Condensing, or High-pressure Blowing, Pumping, Rolling, Winding, and Patent Steam-engines, of any required power, for Irrigating, Draining, Mining, Rolling Mills, or Water Works purposes, and Manufacturers of every description of Chemical, Colliery, Copper Ore, Gold Mining, Glass, and Rock-salt Machinery.

Black-ash Revolving Furnaces of the Most Approved Type.

Bessemer Steel-Rail Plant.

Compressing-Engines for Collieries, Iron Works, and Weldon's Patent Bleaching-Powder Process.

Caustic, Chlorate, Decomposing, Nitre Nitro-Glycerine, Iodine Potash, Sulphur, Acid, and Oxalic Pans.

Gas Producers Patent for Heating and other Purposes.

Pyrites Burners for Irish, Norwegian, and Spanish Ores of Improved Construction.

Patent Rousing Machinery for Brewers.

Retorts, Acid, Gas, Iodine, Nitric, Nitre Nitro-Glycerine and Vitriol Refining.

Steam Superheaters improved for Oil, Tar, and Resin Refining.

Steam Sulphur Melter.

Stills for Oil, Resin, and Tar.

Wheels, Bevel, Mitre, and Spur Moulded on the Shortest Notice by Patent Machinery.

Makers of Mactear's Patent Carbonating Furnace, Jones and Walsh's Patent Sulphate of Soda Furnace, Parnell and Simpson's Patent Causticiser, and Kynaston's Patent Alum Plan

Lists sent on Application.

Photographs, Plans, and other information supplied on receipt of Order.

ST HELEN'S ENGINE, BOILER, AND BRIDGE WORKS AND FOUNDRY,
LANCASHIRE.

CHEMICAL LABORATORY,
WIESBADEN, GERMANY.
Director—Prof. R. FRESENIUS, Ph.D.

LECTURES.

Experimental Chemistry (Inorganic)	Prof. R. FRESENIUS, Ph.D.
Experimental Physics	W. FRESENIUS, Ph.D.
Organic Chemistry Theoretical Chemistry	H. FRESENIUS, Ph.D.
Chemical Technology	E. BORGMANN, Ph.D.
Mineralogy	F. HENRICH.
Microscopy, with exercises in microscopic work	E. BORGMANN, Ph.D.
Practical Instruction in the Laboratory	Prof. R. FRESENIUS, Ph.D., H. FRESENIUS, Ph D., and two Assistants.

The next Session commences on the 25th of April. The Regulations of the Laboratory and the Syllabus of Lectures will be forwarded gratis on application to C. W. KREIDEL'S Verlag, at Wiesbaden, or to the undersigned.

Prof. R. FRESENIUS, Ph.D.

THE CHEMICAL NEWS.

Vol. XLIII. No. 1111.

ON A
SIMPLE AND EXPEDITIOUS METHOD OF PREPARING PYROGALLOL FOR DRY-PLATE DEVELOPMENT.*

By T. E. THORPE, F.R.S.

Pyrogallol, or pyrogallic acid, is made, as the latter name implies, by heating gallic acid: but the process as usually conducted is very uneconomical, on account of the difficulty of preventing the decomposition of the pyrogallol into metagallic acid. According to the equation—

$$\underbrace{C_7H_6O_5}_{\text{Gallic Acid.}} = \underbrace{C_6H_6O_3}_{\text{Pyrogallol.}} + \underbrace{CO_2}_{\text{Carbon Dioxide.}}$$

gallic acid should yield 80 per cent of its weight of pyrogallol, but the amount usually obtained is very much less than this; on the average not more than 30 per cent is formed. The greatest yield is given at a temperature of from 185° to 200° C. If the heat be allowed to rise to 250° the gallic acid is converted into metagallic acid, carbon dioxide, and water, thus:—

$$\underbrace{C_7H_6O_5}_{\substack{\text{Gallic}\\\text{Acid.}}} = \underbrace{C_6H_4O_2}_{\substack{\text{Metagallic}\\\text{Acid.}}} + \underbrace{CO_2}_{\substack{\text{Carbon}\\\text{Dioxide.}}} + \underbrace{H_2O}_{\text{Water.}}$$

The difficulties attending the conversion of gallic acid into pyrogallol have their natural effect on the price of the latter article. Photographers may be interested, therefore, in knowing how they may be able to prepare their own pyrogallol from gallic acid by a very simple and sufficiently expeditious process.

Ten grms. (say 150 grains) of dry gallic acid and 30 c.c. (say one fluid ounce) of glycerin (preferably Price's) are placed in a two-ounce flask or wide test-tube, and heated on a sand-tray to a temperature of from 190° to 200°, so long as bubbles of carbon dioxide are seen to be formed in the liquid. The gallic acid readily dissolves, and in a very short time it is entirely converted into the theoretical quantity of pyrogallol: this fact has been verified by direct observations made in my laboratory. The brown viscous liquid, after cooling, is diluted with 1000 c.c. (say 34 ozs.) of water. A solution is thus obtained, each half-ounce of which contains rather more than one-and-a-half grains of pyrogallol, sufficient, therefore, for developing a quarter-plate according to Mr. Swan's instructions. In containing glycerin it of course resembles Mr. B. J. Edwards's solution, which has found favour with many photographers.

I have developed a number of plates (mostly Swan's) with solutions of pyrogallol procured in this way, with results in nowise different from those obtained by the use of a pure aqueous solution of crystallised pyrogallol of equal strength. The method of conversion is very easy; the only point to be attended to is the temperature, which should not be allowed to exceed 200°, otherwise the glycerin becomes very brown in colour. The thermometer should be supported in the flask or tube by a cork, perforated, of course, to allow of the escape of the carbon dioxide; and the bulb should be surrounded by the liquid, which should be shaken from time to time. The solution may, however, be very dark-coloured without sensibly staining the film, provided, of course, that the time of development be not unduly prolonged—a remark which applies equally to the ordinary method of developing by means of the crystallised acid.

As the present price of pyrogallol is about seven times that of gallic acid, the above process may be worthy of the attention of photographers who practise alkaline development.

---

* Read to the Photographic Society of Great Britain.

LABORATORY OBSERVATIONS.

On the Detection of Iodine in Urine.

By FREDERICK FIELD, F.R.S.

Although it would appear that a solution of an iodide is a very sensitive test for platinum (Chemical News, vol. xliii., p. 75), the converse does not hold good. A platinum salt is not a good test for iodine when the latter exists in small quantities. It would seem that there must be an *excess* of the iodide to develop the rose colour, and hence mere traces are insufficient to cause the colouration of the liquid. This has been observed by Von Cottereau (*Journ. de Chim. Med.*, xi., p. 637), who says:—"Some time ago M. Aquilina recommended the chloride of platinum as a test for iodine and the iodides, it being coloured red by them. According to the author, however, this merely holds good with the iodides—for instance, iodide of potassium—and even in this case the starch is a far more sensitive test for the liberated iodine. Even the acetate of lead is a superior test for iodine compounds to the chloride of platinum."

Platinum salts existing to the extent of one in two millions impart a distinct rose colour on the addition of excess of potassic iodide to the solution, in tubes of about 20 to 25 m.m. diameter, while platinic chloride will afford no colour if the proportion of the iodide to the water in which it is dissolved is less than one to twenty-five thousand.

The employment, then, of a platinum salt for the detection of iodine is useless, as it does not for one moment compare with starch, chloroform, benzol, or carbon disulphide. Urine known to contain iodine in the form of a potassium salt gave no colouration whatever with platinic chloride, although on the addition of starch-water a blue colour was speedily developed when the iodine was liberated, and a drop of chloroform was coloured pink when added to the liquid. Experiments in this direction led me to the investigation of the detection of iodine in urine, which has occupied the attention of many chemists, the results of whose labours are, to say the least, very conflicting. Urine doubtless interferes much with the delicacy of the starch test, a fact pointed out by Löwe (Gmelin's "Handbook of Chemistry," vol. xv., p. 97), who says:—"The blue colouration of starch either does not occur, or is less pure, in presence of tannic acid, a small quantity of gallic acid, pyrogallic acid, or urine." The urea in the urine has generally been supposed to be the substance which interferes with the reaction. Pellagio, in the *Gazzetta Chemica Italiana*, in writing on the detection of iodine in urine by electrolysis, after narrating his experiments, adds:—"These reactions are less delicate in iodised urine than in the pure solution of potassium iodide, because the urea in the urine interferes with them." Giannetti also finds that "urea destroys the colour of iodide of starch, but that urine destroys the colour of this compound more quickly than it would be destroyed by the corresponding quantity of pure urea in aqueous solution." (Watts's "Dictionary of Chemistry," 2nd Supplement, p. 674). My own observations abundantly confirm the latter statement, and lead me to suppose that it is *not* the urea but some other organic matter in the urine to which this reaction is due. Urine contains at most 2 or 3 per cent of urea, and a solution of that body at such a strength in water has but little action, while urine dissolves iodide of starch with the greatest ease. The urine, however, must be undiluted. If the iodide of starch be allowed to settle, and the supernatant liquid filtered off, a small quantity of urine added to the solid matter on the filter, dissolves it immediately, forming a pale yellow solution. After the urine has been voided several days this solvent power is very materially diminished. In spite, however, of this interference, very minute traces of iodine may be recognised in urine if the experiment be carefully watched, and it appears to me that the test proposed by Dr. David Price, viz., nitrous acid, is the most suitable (*Jour. Chem. Soc.*, vol. iv., p. 155). A drop or two of hydrochloric acid is added to the liquid, then a small quantity of clear starch-water, and subsequently a few drops of potassium nitrite. A blue streaky cloud is produced, which vanishes on agitation, if the urine be undiluted, but sufficiently distinct at the time. My observations do not agree with those of Signor Giannetti, although they are not strictly comparable, as in one case, bromine water was employed for the detection of iodine, and in the other nitrous acid. The Italian chemist detected iodine by means of carbon disulphide, when starch-water failed to give any reaction, while, on the contrary, my experiments gave the starch reaction when the sulphur compound refused to show any indication. Several samples of urine were experimented upon, voided by patients who had been taking regularly potassic iodide for some little time. One sample showed the presence of iodine most distinctly by the employment of nitrous acid and starch, and imparted a bright pink colour to chloroform, after liberation of free iodine in the liquid. In four others the blue colour was developed by starch, but neither chloroform, benzol, nor carbon disulphide was coloured when added to the solution. In another sample iodine could not be recognised. It was present, however, for on evaporation of the urine to dryness, and subsequent incineration in a platinum crubible, the residue, after digestion with a small quantity of water, gave abundant evidence of iodine.

Under most circumstances there is scarcely a more delicate test for an iodide than palladous chloride. When urine is present, this reagent is of no avail. One drop of potassic iodide added to a litre of water (the iodide being of only moderate strength) gives a dark brown colour on addition of palladous chloride. In urine, even diluted, there is no change of colour. Still more striking is the reaction of albumen. White of egg dissolved in water coagulates palladous chloride; all the metal is precipitated, not one trace passing through the filter. When potassic iodide in small quantities is dissolved in albuminous water the precipitate is somewhat darkened in the presence of palladium, but the ordinary reaction is altogether disguised. In a moderately strong solution of pure urea there is no difficulty whatever in detecting iodine by the palladium salt.

From the above observations it would seem that neither the platinum nor palladium test can be used with any certainty for the detection of iodine in urine; that the reaction of free iodine on starch water is even more delicate than the same element on carbon disulphide, benzol, or chloroform: and that it is necessary, to prove *with certainty* the existence of iodine in the excretion, to destroy the organic matter before applying the test.

Erratum.—In "Laboratory Observations," Chemical News, vol. xliii., p. 75, line 16 from bottom, *for* "by the introduction of sulphuric acid" *read* "by the introduction of hydro-sulphuric acid."—F. F.

PROTOPLASM.—A COMPLICATED SUBSTANCE.

H. J. Reinke (*Botan. Zeitung*, 38, No. 48) has examined protoplasm obtained from *Æthalium septicum*, and discovered in it the following proximate constituents:—Plastin (an insoluble albumenoid resembling the fibrins), vitellin, myosin, pepton, peptonoid, pepsin, nuclein, lecithin, guanin, sarcin, xanthin, ammonium carbonate; paracholesterin, traces of cholesterin, Æthalium resin, a yellow pigment, glycogen, sugar (non-reductive), oleic, stearic, palmitic, and traces of butyric acids, carbonic acid, fatty glycerides, and para-cholesterides; calcium stearate, palmitate, oleate, lactate, oxalate, acetate, formiate, phosphate, carbonate, sulphate (traces), magnesium (probably phosphate), potassium phosphate, sodium chloride, iron (compound not determined), and water. Plastin can be separated by pressure from the liquid portions of protoplasm. The albumenoids collectively scarcely amount to 30 per cent of the dry substance. Hence the supposition that protoplasm consists of albumen must be abandoned, and we must cease to compare a plasma cell with a particle of white of egg.

NOTE ON THE PREPARATION OF POTASSIC HYDRIC SACCHARATE.

By THOS. BAYLEY.

Pure cane-sugar is dissolved in boiling water in a wide deep test-tube until a boiling saturated solution results. To this liquid an equal bulk of strong nitric acid is added, and the mixture warmed until the reaction commences. This is very violent, and results in the disengagement of voluminous brown fumes. After the evolution of gas has ceased, the liquid is boiled. It is then, while hot, divided into equal parts, and one half neutralised with a strong solution of caustic potash. To this the other half is added, when after a short time an abundant precipitate of acid saccharate is obtained. The salt if slightly coloured is easily purified by passing the hot solution over animal charcoal, evaporating to a small bulb, and re-crystallising

NOTE ON A REACTION OF TARTARIC ACID.

By H. J. H. FENTON, B.A., F.C.S., F.I.C.

In the Chemical News, vol. xxxiii., p. 190, I published a short account of a new reaction of tartaric acid, which I proposed as a test distinguishing it from citric and other acids.

The reaction is brought about by adding to a solution of tartaric acid or alkaline tartrate, a small quantity of ferrous sulphate or chloride, followed by one or two drops of hydrogen peroxide, and finally an excess of caustic potash or soda. A beautiful violet colour is thus obtained, which in very strong solutions appears almost black. At first sight it seemed probable that this colour was due to the formation of an alkaline ferrate. This explanation, however, is not supported by later experiments. The colour, for instance, is readily destroyed by chlorine or hypochlorites in an alkaline solution, which is not the case with ferrates. Moreover, if to the violet solution ferrocyanide of potassium be added, and the liquid be slightly acidulated with dilute sulphuric or hydrochloric acid, the iron may be removed by filtration, and a colourless filtrate obtained, which at once gives the violet colour on the addition of a ferrous salt. Ferric salts produce the same effect, being probably first reduced to the ferrous state, for the solution has powerful reducing properties. Salts of silver and mercury, potassium permanganate, bichromate, &c., are at once reduced by it in the cold. Cupric salts in presence of an alkali are reduced to cuprous oxide in the cold, and to metallic copper on heating.

The solution may be evaporated to dryness *in vacuo* without losing its properties, which are evidently due to some product of the decomposition, or perhaps direct oxidation, of tartaric acid. I hope soon to succeed in isolating this substance, but at present I am unable to obtain it free from admixed tartrates.

Instead of hydrogen peroxide in the above reaction, chlorine water, sodium hypochlorite, or acidulated potassium permanganate, may be used, taking care to avoid excess, but the result is not so good as with the peroxide.

If moist ferrous tartrate, obtained by precipitating a strong solution of an alkaline tartrate with a ferrous salt in the cold, be exposed to the air for a few minutes, and a solution of caustic potash be then added, the violet colour makes its appearance, though only in small quantity. External air produces this effect in a more marked degree than the air of a room, probably owing to the action of ozone. In fact, it is possible that this might afford a rough method of detecting the presence of ozone in the atmosphere. Nitrous acid does not produce the same effect.

This reaction may also be produced by electrolysing a solution of tartaric acid, using an iron plate for the positive electrode. The liquid around this plate turns yellow, and if now a solution of caustic potash be added, the violet colour at once appears.

As a test for the identification of tartaric acid this reaction is one of easy application and of average delicacy. It is necessary, however, to avoid the presence of heavy metals, and of oxidising agents, before applying it.

ARÄOMETRIC METHOD FOR THE ESTIMATION OF FAT IN MILK.

By Dr. F. SOXHLET,

Professor in the Technical High School, and Director of the Royal Agricultural Experimental Station, Munich.

(Concluded from p. 104).

I shall now give further confirmation of the principle o the method and explanations of the manipulations.

The first supposition on which the process is based is that the specific gravity of milk-fat is constant, or only fluctuates in a very small measure. Of the correctness of this supposition, proof has been already cited by means of the control-analyses of milk. Bell (*Journal of the Royal Agricultural Society of England*, 1877) examined 117 different samples of butter-fat, and found the specific gravity of butter at 100° F. In most cases the sp. gr. lay between 0·911 and 0·913, and seldom sank below 0·910. In the 117 experiments the specific gravity was 43 times 0·912, 36 times 0·911, 23 times 0·913, 9 times 0·910, 3 times 0·9094, and 3 times 0·914, *i.e.*, 102 times (87 per cent) between 0·911 and 0·913. Now, if one calculates with the extremes found, 0·9094 and 0·9139, a difference of 0·0045 arises. What then can this difference exercise on the results obtained by the aräometer? The answer is obtained from the following experiment:—

The specific gravity of pure butter-fat was obtained according to Bell at 100° F., and found to be 0·9021; 60 grms. of this fat were melted together with 40 grms. filtered tallow. The specific gravity of this mixture was ascertained to be 0·9081, the difference between the two specific gravities being 0·004.

15 grms. of the butter fat, dissolved in 100 c.c. ether, produced a solution whose specific gravity obtained by the aräometer was 0·7556. The solution of the mixture of fat and tallow, prepared under the same conditions, had the sp. gr. 0·7551. The sp. gr. 0·7556 of an etherial solution of fat, according to the Table, is equal to milk containing 3·51 per cent fat; the sp. gr. 0·7551 to milk with 3·51 per cent. Thus two solutions of fat, equal to those obtained from two samples of milk containing the same amount of fat, but whose density represented both extremes, were examined by the aräometer, and only showed a difference of 0·06 per cent.

Estcourt (Chemical News, vol. xxxiv., p. 254) also proved that the specific gravity of butter fat is a very constant number, which he found at 208° F., to be 0·8700 and 0·8707. Königs (*Industrie-Blätter*, 1878, p. 455) als found that the specific gravity at 100° C. lay between 0·865 and 0·868.

Another supposition is that the same amount of ether is always dissolved by the milk, so that the quantity of ether which forms the etherial solution is always constant. The temperature and the amount of dry substances contained in the milk have an influence, as well as the quantity of water, on the solubility of the ether. The temperature can be easily regulated, so that this influence is removed by using a standard temperature. The difference of the amount of dry substances can have only a trifling influence. The greater part of the casein is precipitated by the caustic potash in the form of very fine flakes, while the fat dissolves in the ether; but casein and fat chiefly cause a change in the quantity of dry substance. The control-experiments—especially those with watered milk—show, besides, that this can have little influence on the results obtained by the aräometric method.

As regards the proportions of milk, caustic potash solution, and ether, they are by no means arbitrary. It is evident that for practical reasons the given quantities may be abandoned without changing the proportion. For the experiments already given, the following quantities were for the most part used, as suitable agitating bottles of 300 c.c. capacity could not be obtained, viz., 185 c.c. milk, 9·25 c.c. potash solution, and 55·5 c.c. ether. I endeavoured to obtain the concentration of the etherial solution as strong as possible, in order to make the error of observation in the reading of the aräometer practicably harmless. But to this endeavour a limit is placed by the etherial solution when it becomes too concentrated, not rising or rising with difficulty to the surface. If, instead of 60 c.c., only 55 c.c. ether are taken for the examination of a milk containing 4½ per cent fat, the ether solution seldom rises to the surface. The proportion of ether to the potash solution has the closest connection with the separation of the etherial solution. 2 c.c., more or less, for the same quantity of ether, have great influence on the separation of the etherial solution. Generally the less potash solution is used the more ether is taken. To find the correct proportions and the nature of the action of the mixture, several hundred experiments had to be made. If the bottle be neglected to be shaken, a gelatine-like mass forms with the ether, which shows no change after several days. The necessity of working with a concentrated solution of fat, made the employment of a comparatively large quantity of milk requisite. But this does not damage the method, as the substance for examination is neither expensive or difficult to procure in quantity; on the contrary, it is a recommendation that the method permits so much of the sample to be used. It is evident that with 200 c.c., the certainty of obtaining a correct average sample is 20 times greater than when only 10 c.c., or less, are used.

The alteration of the specific gravity was found by taking the specific gravities of 10 etherial solutions, obtained from 10 samples of milk containing various amounts of fat at 16·5°, 17·5°, and 18·5° C. The specific gravities, 0·7647 and 0·7452, showed at 16·5° C. an increase, and at 18·5° C. a decrease of 0·9° to 1·0°. This favourable ratio, which allows the correction for temperature to be made without the use of a table, was the principal reason why the amount of fat in weight per cent was not stated on the aräometer.

Commercial ether contains varying quantities of alcohol and water, and is purified by shaking with water. By this means the alcohol is removed and the ether obtained completely saturated with water. The degree of saturation, which differs at different temperatures, has trifling influence on the result. Experiments showed that ether saturated with water at 25° C. gave from 0·01 to 0·02 per cent more fat than that saturated with water at 15° C. To show the great influence which the temperature has on the ether, that measured at 25° C. gave a result 0·1 per cent higher than that measured at 15° C. On that account the temperature of the ether during measurement should not differ more than 1° C. from 17·5° C., that is, from 16·5° to 18·5° C.

In what way the quantity and concentration of the potash solution added influenced the result, was ascertained by a special experiment. When, instead of 10 c.c., 11 c.c. potash solution of sp. gr. 1·26 to 1·27 were used, the sp. gr. of the etherial solution was found 0·3°, and the amount of fat from 0·04 to 0·06 per cent lower. When the potash solution contained 450 grms. to the litre, and had the sp. gr. 1·30, the sp. gr. of the etherial solution was found from 0·1° to 0·2° too low, that is, equal to a difference of 0·02 per cent fat. It is therefore not necessary to be very exact about the preparation and measurement of the caustic potash solution. It is more important that during the shaking of the bottle and the separating of the ether, the temperature be kept constant. How great the error can be, by departing from the instructions, the following experiments will show: 14 bottles were filled in the usual manner with fresh milk containing 3·45 per cent fat.

Solutions 1 and 2 treated in the usual manner according to the instructions, gave :—

Sp. gr. 54·6 = 3·45 per cent fat.
" 54·7 = 3·46 " "

3 and 4, which were placed in water at 15° C., shaken and allowed to stand in water at 15° C. for an hour, gave—

Sp. gr. 55·0 = 3·49 per cent fat.
" 55·1 = 3·51 " "

5 and 6, which were treated in the same manner as 3 and 4, but allowed to stand twelve hours in water at 15° C., gave—

Sp. gr. 55 = 3·49 per cent fat.
" 55 = 3·49 " "

7 and 8, which were treated in the same manner as 3 and 4, but after standing one hour were placed in water at 20° C., and kept twelve hours at this temperature, gave—

Sp. gr. 54·8 = 3·47 per cent fat.
" 54·7 = 3·46 " "

9 and 10, which were shaken, placed in water at 20° C., and kept at this temperature for an hour, gave—

Sp. gr. 54·2 = 3·39 per cent fat.
" 54·0 = 3·37 " "

11 and 12, which were treated the same as 9 and 10, but kept twelve hours in the water at 20° C. gave—

Sp. gr. 54·2 = 3·39 per cent fat.
" 54·1 = 3·38 " "

13 and 14, which were treated in the same manner as 9 and 10, but placed after one hour in water at 15° C., and kept at this temperature for twelve hours, gave—

Sp. gr. 54·5 = 3·43 per cent fat.
" 54·6 = 3·45 " "

The above experiments show that during the operation, and while the bottle is standing, the mixture must be kept at a temperature which must not differ too much from that given in the instructions. A difference of 5° C. makes an alteration in the sp. gr. of 8°, corresponding to 0·1 to 0·14 per cent fat. But it is also seen that 1° C. more or less does not make much difference. The standing of the mixture, after the separation of the etherial solution, has no influence on the result if the temperature be constant. The red colour of the mixture which is observed after long standing arises from the decomposition of the milk-sugar by the caustic potash, and has no influence on the estimation. The amount of shaking is unimportant, the same result being obtained whether the bottle be shaken ten minutes or one hour; the error of observation consists at highest of 0·04 per cent; I have, at least, never obtained a greater difference from a hundred control-experiments, which I made during the perfecting of the process.

It is of the greatest importance for the correctness of the results that the aräometer be exact, and that the scale be divided as I have described. It is also necessary that the thermometer of the aräometer, at least, for the temperatures between 16·5° and 18·5° C., be correct to 0·1° C.

Herr Johannes Greiner, Munich, makes the aräometer according to a standard one, which was carefully revised by me in ten points, and sells none which has not been compared in eight points with the standard in the laboratory of the experimental station. The complete apparatus may be obtained from the above firm.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, March 3rd, 1881.

Prof. H. E. Roscoe, President, in the Chair.

The following certificates were read for the first time :— G. H. With, F. J. Farroll. It was announced that a ballot for the election of Fellows would be held at the next meeting of the Society (March 17). The new list of the Officers and Council proposed for the ensuing year, as announced in our last report, was read from the Chair.

The President then called on Mr. F. Hatton to read a paper "*On the Action of Bacteria on Various Gases.*"* The experiments were made to ascertain the nature of the action exerted by various germs on the life and increase of bacteria, and to observe what influence the bacteria had on the percentage composition of the gases. The bacteria were obtained by shaking fresh meat with distilled water. The aqueous extract was filtered and exposed to the air for twenty-four to thirty-six hours; it was always found to be full of bacteria. A small flask was half filled with mercury, filled up with the bacteria solution, and inverted in a mercury trough. The gas under examination was then passed up, a small glass vessel was introduced under the mouth of the flask, and the whole removed from the trough. The liquid was examined daily as to the condition of the bacteria, the sample being removed by a piece of bent glass tubing having an india-rubber joint. After about a week the gas was pumped out by means of a Sprengel and analysed. Atmospheric air was first tried. The bacteria lived well during the fifteen days of the experiment (T. 15° to 22°). A large absorption of oxygen took place, but it was not replaced by carbonic anhydride; in a second experiment (T. 25° to 26·5°), 20 per cent of oxygen disappeared, and only 17 per cent of CO_2 were formed. Pure hydrogen after fourteen days had no action on the bacteria; the gas contained 0·34 per cent CO_2, 98·94 per cent H. Pure oxygen after ten days was converted into CO_2 29·98 per cent, O 70·02 per cent. A mixture of CO 46·94 per cent, CO_2 1·27, O 1·27, N 50·51, was next tried after fourteen days; the gas contained CO_2 17·77, CO 0·55, H 7·58, CH_4 2·50, N 71·57. In all of the above cases the bacteria flourished well. Cyanogen was next tried. The solution of meat turned gradually to a thick black fluid. On the fifth day very few bacteria could be seen. From this time, however, they increased, and on the twelfth day were comparatively numerous. On the fifteenth day the gas was analysed; it contained CN 5·35, CO_2 57·59, O 2·24, N 34·79; a second experiment gave similar results. It appears, therefore, that cyanogen is fatal to bacteria as long as it exists as such, but that it soon decomposes into ammonic oxalate, &c., and that the bacteria then revive, especially in sunlight. Sulphurous anhydride was next tried; the bacteria lived during the fifteen days; the gas contained CO_2 7·87, O 0·00, N 2·13, SO_2 90·10. Similar results were obtained with nitrogen, nitrous oxide, nitric oxide, carbonic anhydride, a mixture of H and O obtained by the electrolysis of water, and coal gas; in all cases the bacteria lived well during the experi-

---

* This paper obtained for the author the Frankland Prize of £50 at the Institute of Chemistry.

ment. The author next experimented with a solution of urea (0·98 per cent) and phosphate of potash (0·4 per cent), sowing it with bacteria. The bacteria lived well during the fourteen days of the experiment; small quantities of gas were evolved containing 0·53 per cent CO_2, 2·64 per cent O, and 96·82 per cent N. An experiment was made with spongy iron, air, and bacteria. On the fourth day, all the bacteria had vanished; the air was analysed on the fifth day, and consisted of CO_2 0·26, O 0·00, and N 99·74 per cent. Experiments were also made with acetylen salicylic acid, strychnine (10 per cent), morphine, narcotine, and brucine; none of these substances had any effect on the bacteria. On the other hand, phenol, spongy iron, alcohol, and potassium permanganate were very destructive to these microscopic growths.

Mr. W. M. Hamlet said that these experiments confirmed some observations of his own. He had found that bacteria could exist in almost anything—in carbonic oxide, hydrogen, 1 per cent creosote, phenol, methylamin, methylic alcohol, chloroform. Moreover, Crace-Calvert had shown that they could live in strong carbolic acid. In reply to Mr. Warington the speaker said that the acetic acid fermentation went on in the presence of chloroform.

Mr. Kingzett called attention to the fact that the oxygen was completely used up when the meat infusion was placed in contact with air. He did not think the experiments represented the action of bacteria on gases or of gases on bacteria, but rather the effects of various gases on the mode and extent of ordinary putrefaction.

Dr. Frankland expressed his satisfaction with the results obtained by the author in his laborious research. He must confess that these results had surprised him not a little. The fact that bacteria, which were real organisms and could not be shielded under the term putrefaction, lived and flourished in SO_2, CO, CN, &c., seemed to him very extraordinary, and the question arose whether the germs to which infectious diseases were probably due were not similarly endowed with a power of great resistance to ordinary influences.

Mr. F. J. M. Page said that Dr. Baxter had proved that with some fever-producing liquids, their virulence was destroyed by chlorine and sulphurous acid, and that he had seen some experiments at the Brown Institution which led to the same conclusion; so it seemed that, at all events in some cases, the virulence of infective liquids was due to organic matter, essentially different from the bacteria observed by Mr. Hatton.

Mr. Hatton then read a second communication "*On the Influence of Intermittent Filtration through Sand and Spongy Iron on Animal and Vegetable Matters Dissolved in Water, and the Reduction of Nitrates by Sewage, &c.*" Filtration through sand:—A 14-ft. vertical glass tube, 3½ ins. in diameter, was filled with sand. The water was passed through at the rate of 4 litres per day. Experiments were first made with peaty water diluted with its own volume of distilled water. The organic carbon decreased 1·527 parts per 100,000, whereas the organic nitrogen was but little affected. The addition of a nitrifying material, in the shape of 5 c.c. of stale urine added to 4 litres of water, did not promote the oxidation of the organic nitrogen of the peat during filtration. A filtered infusion of rape cake was substituted for the peaty water and similar results were obtained. Some experiments are then given as to the effect of sewage in promoting the reduction of nitrates. A 5 per cent solution of clear fresh sewage containing no nitrates was added to a solution containing 0·0853 grm. of nitre. The mixture was shaken in a large stoppered bottle, and estimations of the nitric nitrogen made from time to time. For a time the nitric nitrogen steadily diminished, until, in fact, the sewage itself began to nitrify, and then the amount increased. At low temperatures the sewage does not seem to nitrify. It was found that when a solution containing nitrates and sewage was allowed to stand in contact with air, the oxygen in the dissolved air increased 4·5 per cent, while that in the air above the liquid decreased 5 per cent. In sixteen days the N as nitrates and nitrites decreased from 0·406 part per 100,000 to 0·075. Thick sewage was much more active than clear sewage. Spongy iron, when shaken up with a solution of nitre, converts the nitrogen into ammonia and free nitrogen. Filtration through spongy iron rapidly reduces the nitric nitrogen, converting it for the most part into ammonia. Filtration of peat solution and solution of egg albumen through spongy iron rapidly removed both the organic nitrogen and organic carbon, no nitric nitrogen being formed, all the nitrogen being reduced to ammonia. In some cases the carbon seemed to give rise to some marsh-gas.

Prof. Tidy then read a paper on "*River Water.*" In a previous paper the author discussed the action of the three principal agents to which the self purification of running water is due—subsidence, the scavengering propensities of fish, and the oxidation of the organic matter, this oxidation being effected partly by the oxygen in the atmosphere, and partly by the oxygen liberated by plant life. The present communication is a reply to the criticisms of Dr. Frankland on the former paper, and to a paper by Miss Halcrow and Dr. Frankland on the oxidation of peat. First as to the oxidation of peat. Notwithstanding Dr. Frankland's objections, the author still maintains that the Shannon is admirably adapted to prove oxidation, should such a process be going on. Admit the ever recurring entrance of feeders of peaty water, if it can be shown that in spite of this constant addition of peaty matter there is a manifest lessening of the peat in the water, then the experiment, considering that all the chances and conditions are against proving oxidation, becomes a hundredfold more conclusive than it would otherwise be. Admitting that at four points along a course of forty miles, at Portumna, Killaloe, O'Briensbridge, and at the junction of the Mulcaire, the organic elements do indicate a fairly uniform quantity of peat in the water, the question remains, what has become of the floods of peaty matter which have entered the river during its forty mile flow? Why does not the peat in the river increase in quantity yard by yard? Starting with a brown water at Killaloe the river should be black over and over again before it reaches Limerick. The author sums up this part of his paper thus:—I cannot question for a moment that peat is got rid of in the course of the flow of a river, and that oxidation is one of the agencies concerned in its accomplishment. He then criticises the paper by Miss Halcrow and Dr. Frankland on "The Action of Air on Peaty Water," and objects that in no sense are these experiments in which the same dribble of water is brought ever and anon into contact with the same few bubbles of air, comparable to the case of the Shannon—a river of great volume—in free and open contact with an ever-changing sea of air—luxuriant with vegetable life and fish. In one series of experiments, in which some peaty water was allowed to remain for a year in contact with some air in a stoppered bottle, the author objects that, admitting oxidation to have occurred at the layer where actual contact took place between the water and air, any carbonic acid formed would act as a party wall to divide the water from the purer air above, and, making all allowances for diffusion, there practically would be an end of the process. He also points out that the carbonic acid was in enormous excess in the air above the water, viz., 14·7 parts in 10,000. In passing, the author criticises Dr. Mills's remarks, and maintains that though the combustion and the oxygen processes both give valuable results the latter is the better of the two. In the second part of the paper the author discusses the oxidation of sewage matter by running water, and contends that if sewage be discharged into a river so that the pure water is twenty times the volume of the sewage, after a moderately rapid flow of a few miles, the whole of the impurities will, by oxidation and other agencies, disappear, and the water be again restored to its original state of purity. He objects to the opinion of the late Sir Benjamin Brodie on the point in question, as he was a witness who had not made a single experiment bearing on this subject; he then quotes many other opinions favourable to his views, and points out that the Commission of 1850 and 1869, and the Select Committee of 1867, approved of the Thames, notwithstanding the sewage, as a source of water supply. Dr. Frankland's experiments on the Irwell, the Mersey, and the Darwen are next considered. These are, says the author, notoriously polluted sewage rivers containing no vegetation, devoid of fish, and everything was against the regaining of purity, yet Dr. Frankland's results show in the case of the Darwen a decrease of organic elements of 41 per cent, and in the Irwell of 31 per cent. Again, in the case of the Tees, a river polluted at Barnard Castle by sewage and refuse from dyers and fellmongers, after a flow of 16 miles, this river is reported at Darlington by Dr. Frankland as of unimpeachable quality, bright, and palatable. As to Dr. Frankland's statements that in the Severn a flow of 30 yards reduces the organic elements by 32 per cent, and that after a flow of a mile they were only reduced 12 per cent more, the author contends that sewage is not of a constant composition, and that some constituents are much more easily oxidised than others. As regards the wonderful diminution of chlorine remarked by Dr. Frankland, the author still maintains that it was taken up by vegetation, and quotes an experiment in which he watered some watercress with a solution containing 40 grains of salt per gallon, and increased the quantity of chlorides by 220 per cent. With respect to Dr. Frankland's criticism on the experiments with sewage in troughs, the author states that the sewage used was filtered. To the criticisms of Profs. Tyndall and Huxley, the author replies by quoting the statistics of ten years, which prove that zymotic diseases do not necessarily result (sewage or no sewage) from drinking river water, any more than they can be kept away by drinking chalk water. He asks Prof. Huxley this question—Can he give one single well-authenticated case where a drinking-water in which the chemist failed to detect manifest contamination has caused disease? The author concludes by asking Dr. Frankland—As the dangerous element in a water is entirely outside his ken or detection, what in his judgment is the good of water analysis? Seeing that 100,000 bacteria may be present in a gallon of water, each bacterium being capable of imparting disease, and yet be undetected by the most refined chemical processes, How can he report any water to be wholesome? What are his grounds for reporting a water containing 0·1 of organic carbon to be of good quality, and a water containing 0·4 of organic carbon to be of inferior quality, seeing that the first made contain millions of bacteria, which may be entirely absent from the second? Why should absolute immunity from epidemics of cholera be promised if only London would drink chalk-water, which after all is merely rain-water, and must have fallen in certain parts on heavily manured land, and has afterwards filtered naturally through chalk, and yet it be stated that there is not a tittle of trustworthy evidence to prove that artificial filtration (which, judging from analyses, is more complete than natural filtration) affords any safeguard against the propagation of epidemic diseases.

The President said that the Fellows had just listened to a powerful and interesting paper, which was sure to lead to a lively discussion. As it was very late he hoped the discussion would be strictly confined to the question of oxidation.

Mr. Hawksley had listened to the papers with much interest; much learning had been displayed, and many ingenious and elegant phrases had been used, but he did not think that anything like a solution of the process of purification as it existed in nature had been arrived at. As a practical man he would say, What does nature teach us? If we go to a mountain covered with peat we see inky water on the surface, and yet a very few feet below springs of water rise perfectly colourless and bright. This is nature, not chemistry. Similarly a stream may receive the sewage of towns, and run into the ocean without any colour at all. Moreover, the sewage of millions of inhabitants had been running into the ocean for years, and yet it remained to all appearance free from sewage. On the surface of the ocean one might well say, "Water, water, everywhere, and not a drop to stink."

Dr. Frankland said that it would be difficult to notice at that late hour all the salient points of Prof. Tidy's elaborate paper, but he would endeavour to refer to some of them. Prof. Tidy has explained that the purification of rivers is effected by three processes—subsidence, the action of fish life, and oxidation. As regards the second, he does not clearly state whether the fish remove organic matters in suspension or in solution. Fishes by respiration must clearly remove oxygen from the water, so it would seem that they could only remove organic matter in suspension; however, the substantial difference of opinion was on the question of oxidation, to which he would therefore confine his remarks. He would have liked to have said something about the admirable paper by Mr. Hatton, but as time pressed he must leave the results to speak for themselves. First, as to the oxidation of peat in the Shannon, Prof. Tidy states that in a flow of one mile from Killaloe the organic carbon decreases from 0·8 to 0·48. This really means that half of the total organic matter has been converted into carbonic anhydride, water, and nitrogen or ammonia in the flow of one mile. He would ask any chemist who has been accustomed to organic compounds whether he is acquainted with any substance which behaves in this way? To take one instance: aldehyd, a substance most prone to decomposition, under similar circumstances, would hardly be oxidised perceptibly. How improbable is it that the flow of a mile should cause such an enormous reduction, whilst the exposure of 51 square miles of surface in the loch above should have such a slight influence! Does Prof. Tidy really think that this entrance of feeders of peaty water has any very great influence on the composition of the Shannon, a river which drains about a quarter of Ireland? None of these feeders have a flow of more than a mile, and so they cannot be insignificant. He must take exception to two of the three new analyses which Prof. Tidy gives, namely, those taken one mile below Castle Connell and at Limerick: because the entrance of the largest tributary, the Mulcaire,—a river containing but little organic carbon and much suspended mineral matter (which in its deposition carries with it much organic matter),—completely prevents any fair comparison between these two places. Prof. Tidy had somewhat ridiculed the experiments which he had carried out with Miss Halcrow, on the oxidation of peaty water by agitation in a bottle with air; and Prof. Tidy, moreover, made the extraordinary statement "that, admitting oxidation to have occurred, any carbonic acid formed would probably act as a party wall to divide the water from the purer air above." Now any scientist who can accomplish such a conception without any great effort of the imagination can accomplish anything if he wishes it. This notion of a gas playing the part of a party wall need not be further alluded to. The percentage of CO_2 in the air above the peaty water, 14·7 parts in 10,000, which Prof. Tidy calls an enormous excess, is readily accounted for, as the air in the laboratory contained 9 parts, and the gases dissolved in the peaty water 199 parts in 10,000. Notwithstanding Prof. Tidy's great faith in Nature, and his objection to any experiments in a bottle, the speaker ventured to say that in the case of the bottle which was fastened to the connecting-rod of the steam-engine, the water was brought into contact with air much more perfectly than in Nature, and yet no oxidation could be detected. If the permanganate process detects volatile organic matter which is missed by the combustion process, why does Prof. Tidy not prove his point by estimating the oxygen required by a water before and after boiling. He must protest against the ignorance which was ascribed to Sir Benjamin Brodie: few people had more opportunity of studying the action of oxygen on organic bodies, and he was justified by this experience in stating that it was absurd to say that organic matter could be oxidised by rivers in such an easy way, although he had not made any experiments directly with river water. Prof. Tidy omitted to state, with regard to the supposed decrease of 41 per cent of organic elements in the Darwen, that between these two points its volume had doubled, and that when a correction was made for this observed increase in volume the 41 per cent became 13·2 per cent, and occurred in the organic nitrogen, and no decrease was observed with the organic carbon. The Thames was recommended as fit for drinking purposes by the Commission of 1869, only if the sewage was diverted and the water efficiently filtered. As to the oxidation in the Severn, where a flow of 30 yards diminished the carbon by 32 per cent,—the time taken to flow 30 yards could not be more than a minute,—"if," said Dr. Frankland, "I believed that some substance in the sewage oxidised at this rate, I would endeavour to isolate it and bring it before this Society; it would undoubtedly burst into flame when exposed to the air." Then we are asked to believe that in one minute the plant-life reduces the chlorine by 40 per cent in this section of the river. The two circumstances taken together, the diminution of the organic carbon and the chlorine, point irresistibly to dilution. In reply to Prof. Tidy's questions, he would say that water analysis tells us whether water has been contaminated with sewage, and if so, when; that a water is reported as wholesome and fit to drink when it has been filtered exhaustively through a thousand feet of porous material: on this point he should like to ask Prof. Tidy how he can report a water as turbid and yet as perfectly wholesome. If a river water contains 0·4 of organic carbon it has a disagreeable peaty taste. In conclusion he hoped that Prof. Tidy would, after reading Mr. Hatton's paper, change his opinions, and no longer believe in the utter destruction of bacteria by a cold bath in the Thames; when they withstood the action of cyanogen and sulphurous acid, it was difficult to see why they should commit suicide by bursting their envelopes by endosmosis.

Dr. **Gilbert**, whose remarks were received with hearty approbation, wished to raise a protest against the tendency of Prof. Tidy's paper; it, whether intentionally or not intentionally, virtually advocated the discharge of raw sewage into a river, the water of which was to be used afterwards for drinking purposes. Now there is no doubt whatever that sewage after passing over land is immensely purified, the organisms are got rid of, and the ammonia is oxidised; and it would be a great misfortune, now that much was done in this direction, after twenty years' hard work, if it should be understood by the public outside this room that the Fellows of the Chemical Society at all advocated the discharge of raw sewage into a river.

The **President** said that all must echo the remarks of Dr. Gilbert; they were most opportune. It seemed that there were two distinct questions. There was no doubt that the peaty matter in a river does disappear, but the oxidation of germs or bacteria was another question. Had Prof. Tidy any proof that these organisms were oxidised?

Dr. **Bischoff** asked Prof. Tidy whether his statistics included any year when there was an epidemic disease. As to the effect of spongy iron on bacteria he would refer the Fellows to a paper on the state of Shoeburyness, in the *Lancet* of December 25th.

Mr. **Kingzett** said that oxidation in Nature was probably not direct, but was effected by the infusoria, bacteria, &c.

Prof. **Tidy** very briefly replied. He disclaimed all intention of ridiculing Dr. Frankland's experiments, or of imputing ignorance to Sir Benjamin Brodie. He quite agreed with Dr. Gilbert's remarks; it was a very serious matter to introduce raw sewage into a river. He should always prefer deep-well water; he was emphatically a water purist. He had not the least doubt that sewage ought not to go into the river. He could not understand that shaking up water in a bottle was comparable to a running stream. Statistics are the best proof that organised matters are oxidised.

A paper by Dr. F. R. **Japp** and C. **Colborne Graham** "*On β-Diquinolin*," was taken as read. The quinolin employed was prepared from a mixture of aniline, nitrobenzine, glycerol, and sulphuric acid; it boiled at 229°. Equal volumes of quinolin and benzoyl-chloride were heated in sealed tubes to 240° to 250° for six hours. A crystalline product was obtained, which was boiled with strong HCl, filtered, extracted with ether, and finally precipitated with caustic soda. The base was obtained in colourless satiny laminæ, fusing at 191°, soluble in chloroform and boiling benzine. Analysis indicated the formula $C_{18}H_{12}N_2$. Its salts are diacid. A platino-chloride was prepared. The authors suggest the name α-diquinolin for the liquid prepared by Greville Williams.

The Society then adjourned to March 17th, when the following papers will be read:—"On the Volumes of Mixed Liquids," by F. D. Brown; "On Boron Hydride," by F. Jones; "On the Action of Aldehyds on Phenanthraquinon in presence of Ammonia," by F. R. Japp; "On the Action of Benzoic Acid on Naphthaquinon," by F. R. Japp; "On the Alleged Formation of Nitrous Acid during the Evaporation of Water," by R. Warington; "On the Absorption of Solar Rays by Atmospheric Ozone, and on the Blue Tint of the Atmosphere," by Prof. Hartley; "Note on the Sweet Principle of *Smilax glycyphylla*," by C. R. A. Wright and E. H. Rennie.

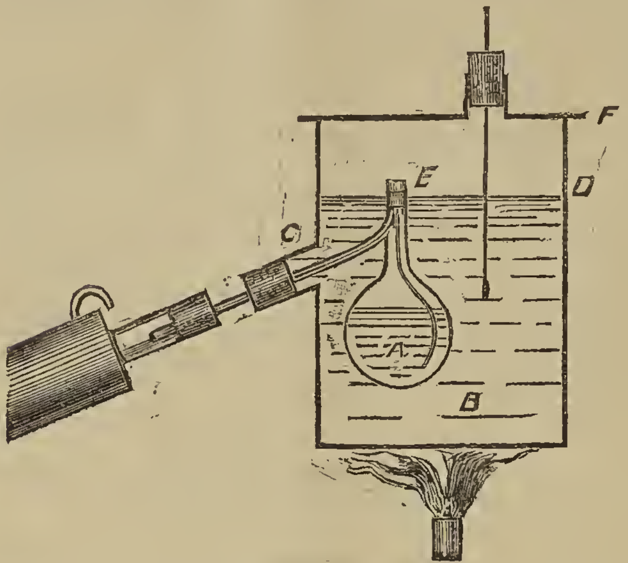
CORRESPONDENCE.

BENZOL TESTING.

To the Editor of the Chemical News.

Sir,—I have read with interest the discussion on this subject, because I have lately had a little experience with this so-called "practical test," by which benzol is bought and sold. The instructions as to how this test is to be applied is, I understand, usually printed on the contract note, and the main points to be observed are these:—First. A retort is to be employed connected with a Liebig's condenser. Second. A thermometer is to be fitted into the retort, the bottom of the bulb of which is to be placed ⅜ths of an inch from the bottom of the retort. Third. 100 c.c. of the benzol to be tested are to be placed in the retort. Fourth. Heat is to be applied by the flame of a Bunsen burner. Fifth. The distillation must be carried on so that the distillate falls rapidly in separate drops from the end of the refrigerator. Sixth. The temperature is to be allowed to rise to 100° C., the flame then taken away and the distillate measured. Similarly, the temperature is then carried to 120° C. and the distillate measured, and the measure of these distillates in cubic centimetres are supposed to give the percentages of "100° and 120° C. benzol" respectively. If any one practises for some time with the same apparatus, the same size of flame, and observe as nearly as possible the same conditions, he will, doubtless, get very nearly the same result in different experiments with the same benzol, but it is almost impossible that two persons making this test with different apparatus could get the same result. If it be considered necessary to place the bulb of the thermometer at an exact distance from the bottom of the retort, why not stipulate for the kind of thermometer to be used: there are some thermometers which have bulbs, say, ⅜-inch long, and some with bulbs 1 inch long. If two such thermometers be placed at equal distances from the bottoms of the retorts, the whole of the mercury in the shorter bulb will be nearer the source of heat than in the longer bulb. Then, as to the size of flame and mode of heating, I found that I could raise the temperature above 100° C., before 20 per cent of distillate had passed over from a "50 per cent benzol," whilst the distillate fell rapidly in drops.

It is difficult to understand why such a stupid process should be adopted as a practical test, when, with less trouble and attention to detail, a process could be used which, taking the barometric pressure into account, would give the same results in the hands of any one. The process I refer to is this :—A flask (A) with a tube passing from the neck is placed in a cylindrical copper box (B), the small tube passing through a cork fitted into a hole in the side of the box (C) passes through another cork fitted into a Liebig's condenser. The sample to be tested is placed in the flask (A) by means of a funnel with a long stem, and the mouth (E) corked by an ordinary cork or well-fitting glass stopper. The copper box is filled with water to the point (D), and the water boiled so long as any distillate passes over. This gives the distillate at 100° C. The water may then be syphoned out of the box, a loosely fitting lid (F), with a thermometer passing through it, put on, and the copper vessel used as an air-bath, which is heated to 120° C. so long as any distillate passes over. If a process such as this were adopted, serious discrepancies in the results of different persons testing the same sample would be no longer possible.—I am, &c.,



William Thomson.

Manchester, Feb. 26, 1881.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Bulletin de la Société Chimique de Paris.
Nos. 6 and 7, October 5, 1880.

Chemical Section of the Sixth Congress of Russian Naturalists and Physicians.—A. Krakau.—M. Menschutkine described the chief results obtained by M. Klimenko in his researches on the isomers of lactic acid.

M. Gustavson gave an account of his researches on the displacement of chlorine by bromine in the chlorides of carbon, and explained his theory of the reactions which take place under the influence of aluminium chloride and bromide.

M. Sabaneeff stated that the differences between the boiling-points of the analogous halogenous derivatives which correspond to ethyl hydride and ethylen are almost constant, and vary only with the nature of the halogen, independent of its quantity.

M. Andreeff exhibited his automatic apparatus for prolonged filtration.

M. Menschoutkine gave an account of the etherification of the non-saturated monobasic acids.

M. Kajander described his researches on the speed of the solution of magnesium in different acids.

M. Winogradoff gave an account of the reaction of aluminium chloride and acetyl chloride.

M. Gustavson read a preliminary communication on the action of the alcoholic bromides and C_2Br_6 in presence of aluminium bromide.

M. Hemilian announced that in causing aluminium chloride to react upon the chloride corresponding to fluorenic alcohol, dissolved in an excess of benzine or toluene, there is produced diphenylen-phenyl-methan or diphenyl-cresyl-methan. He then described the preparation and properties of diphenyl-para-xylyl-methan and diphenyl-naphthyl-methan.

M. Colley described his researches on the preparation of saccharose from glucose.

M. Beilstein gave an account of the results obtained by oxidising dinitro-α- and β-naphthalines with nitric acid.

M. Potilitzine described the action of hydrogen upon the halogen compounds of silver.

M. Beketoff exhibited the displacement of the sodium in its oxide by hydrogen, and the combination of sodium oxide with carbonic anhydride.

M. Beilstein announced that the dinitro-toluidine derived from tri-nitro-toluene is different from that obtained by the action of nitric acid upon para-toluidine.

M. Menschoutkine produced novel data on the structure of the sorbic and the hydrosorbic acids.

M. Zagoumenny has prepared tetra-phenyl ethan by the action of nascent hydrogen upon the ether of diphenyl-carbinol dissolved in acetic acid.

M. Bogomoletz communicated the results of researches on the action of zinc-ethyl on the mono-chloro-, bi-chloro-, and tri-chloro-acetyl chlorides.

M. Wroblewsky shows that solid nitro-xylene gives on oxidation nitro-iso-phthalic acid, and that xylidine, obtained by the reduction of solid nitro-xylene, gives, on treatment with nitric acid, two nitro-xylidines.

M. Flekkel described his researches on the extraction of potash from the suint of Russian wools.

M. Konovaloff announced that the butylene obtained by the action of sulphuric acid upon iso-butylic alcohol does not form a homogeneous body.

M. Flavitzky presented a preliminary communication on a law of the variation of the specific heat of gases and vapours with the change of temperature.

M. Schœne affirmed that we possess hitherto no clear and decided proof of the existence of ozone in the atmosphere.

M. Potilitzine also expressed the opinion that ozonometric papers containing potassium iodide cannot show distinctly the presence or absence of ozone in the air, as they are affected even by carbonic acid.

M. Tchirikoff pointed out a new method of determining the hydrogen and carbon in coal.

M. Wischnegradsky explained the results of his researches on the reduction of quinoline and ethyl-pyridine.

M. Pœhl read a paper on pilocarpine.

M. Kostitcheff communicated a memoir on the combinations in which phosphoric acid is found in the soil.

M. Boutlerow made some remarks on the structure of the poly-combinations of mineral chemistry.

M. Flavitzky handed in a treatise on certain properties of the terebenthenes.

M. Danilewsky sent a memoir on the albumenoid bodies.

M. Goloubeff gave a communication on the dinitro-derivatives of desoxybenzoin.

M. Dianine finds that if phenol is mixed with chloride of lime it is chiefly converted into a trichloro-derivative.

M. Tawildaroff announced that on causing chlorine to react upon ethylidene chloride in presence of aluminium chloride there is formed exclusively trichloro-ethan.

M. Tchech described his researches on several varieties of the hop found in the south of Europe.

M. Stcherbakoff has studied the formation of a secondary alcohol under circumstances in which there have been hitherto obtained merely tertiary alcohols.

M. Ossipoff has undertaken an investigation on the reduction in acid solutions of the substituted fumaric and maleic acids.

M. Eltekoff explained the chief results of his researches on the phenomena of the migration of atoms.

M. Kabloukoff, in order to obtain one of the glycerins containing 6 atoms of carbon, has reduced allyl-aceton to an alcohol, and transformed the latter into an acetic ether, and by means of the latter he has prepared aceto-brom-hydrine.

M. Beletzky has investigated the decomposition of phosphorites by peat in presence of various salts.

M. Pavlevsky gave an account of an acid extracted from *Viscum album*.

Nos. 8 and 9, November 5, 1880.

Researches on Nicotine.—A. Cahours and A. Etard.—In this extensive memoir the authors give an account of thio-tetra-pyridine, its salts, its behaviour with metals, its oxidation-products, and of the bromised derivatives of nicotine.

Synthesis of Biguanide.—R. Herth.—The author, by treating sulphurea with an ammoniacal solution of copper hydroxide in the water-bath, obtains dicyano-diamide, and a secondary product, which he has transformed into a double sulphate of copper and of biguanide.

Para-gluconic Acid, an Isomer of Gluconic Acid.—M. Honig—This acid differs from its isomers, the gluconic, dextronic, and mellitic acids, by the circumstance that its alkaline salts are crystalline, whilst those of the acids just mentioned are amorphous.

No. 10, 1880.

This number contains no original communications, but merely extracts from other journals which have been or will be noticed under their proper heads.

Journal de Pharmacie et de Chimie.
September, 1880.

Report Submitted to M. Riche to the Academy of Medicine on the Substitution of Margarine for Butter and Lard in the Public Asylums of the Department of the Seine (Conclusion).—The author finds that pure butter yields a quantity of fatty acids insoluble in water ranging from 86·5 to 88 per cent of the weight of the pure fatty matter, whilst in all the other fats and animal oils, and in almost all vegetable oils, there is from 95·20 to 95·80 per cent of insoluble fatty acids.

Solution of Chlorine in Water.—M. Berthelot.—Already noticed.

Remarks on the Saccharoses.—M. Berthelot.—The author refers to the similarity between the saccharine of Peligot and trehalose. He asks whether these approximations show really the analogy of chemical function in these two sugary matters, conformably to the ancient ideas of Laurent on hemimorphism, or do they result from some theoretic limit in the number of possible crystalline forms, or are they purely accidental? M. Berthelot also calls attention to the unequal resistance of sugars to the action of sulphuric acid. Cane-sugar and melitose are almost instantly modified by the hot acid, which is not the case with melezitose, trehalose, and sugar of milk.

Wines made from Dried Grapes (Conclusion).—M. Reboul.—Wines made from raisins are not always lævo-rotatory. This may be the case with the wines of Corinth and Thyra, but it does not hold good with the wine of Vourla, which is either optically inactive or feebly dextro-rotatory. If the alcoholic fermentation is not complete, and there remains a somewhat notable quantity of sugar, the lævo-rotatory power increases with time, or even passes from the right to the left.

A Compound of Chloral Hydrate and Camphor.—P. Cazeneuve and M. Imbert.—If solid camphor is added to solid chloral hydrate, the two bodies become totally liquefied, and give rise to a colourless syrup, which the authors regard as a true compound.

Apparatus for Producing Hydrogen Sulphide, Carbonic Acid, Hydrogen, Nitric Oxide, &c.—F. Bellamy.—This apparatus cannot be intelligibly described without the accompanying cut.

Detection and Determination of Heavy Mineral Oils, Resin Oils, Fatty Oils, and Resin in the Oils of Commerce.—A. Remont.—Already inserted (see Chemical News, vol. xlii., p. 39).

Specific Identity of the Inulines of the Synanthereæ and of Natural Levuline.—M. Lefranc.—The author thinks it necessary to revert to the old view of the identity of the inulines from different sources.

The Spectroscope Applied to Chemical and Pharmaceutical Science (Continued).— M. Coulier. — An illustrated paper.

October, 1880.

Preparation of Chlorine.—M. Berthelot.—Already noticed.

Cinchona Barks of Java sold in Amsterdam in 1880.—G. Planchon.—The author gives a tabular view of the varieties of bark, their localities, analyses, and prices.

The Spectroscope Applied to Chemical and Pharmaceutical Science.—M. Coulier.—A continuation of a memoir which does not admit of abstraction.

Report on Scilla Maritima.—MM. Riche and Rémont.—This paper is rather of a pharmaceutical than a strictly chemical character.

Wines from Dried Grapes.—This paper is chiefly concerned with the determination of the sugar.

Hydrobromic Acid as a Reagent for Copper.—A drop of the solution in question is placed in a watch-glass, a drop of hydrobromic acid is added, and the mixture evaporated at a gentle heat. When it is reduced to the bulk of one drop a rose-red colouration appears, three or four times more intense than that produced by potassium ferrocyanide. In this manner 1-100th milligrm. copper may be detected.

Detection of Ergot in Flour.—The suspected sample is treated with cold ether or boiling alcohol to dissolve the greater part of the colouring-matters of the flour. The residue is then extracted with ether, mixed with a small quantity of sulphuric acid, and the extract is examined with the spectroscope. The ethereal extract of ergot, if concentrated, absorbs all the refrangible portion of the spectrum beyond D; if the solution is diluted, the spectrum is enlarged, and there appear three absorption-bands: the first between D and E, wave-length 538; the second between E and F, wave-length 499, and the third between F and G, wave-length 467. Hoffmann agitates the acid ethereal extract with a little solution of sodium bicarbonate, which seizes the colouring-matter of the ergot and takes a fine violet colour, whilst the colouring-matters of the flour remain in the ether.

New Characters of Guanine.—Stefano Capranica.—Characteristic reactions are obtained with picric acid, potassium chromate, and ferrocyanide.

November, 1880.

Notes on the Materia Medica of the United States.—G. Planchon.

Detection of Methylic Alcohol in Vinic Alcohol.—MM. Cazeneuve and Cotton.—The authors propose as reagent a solution of potassium permanganate containing 1-10th per cent of the dry salt. The permanganate at ordinary temperatures is reduced slowly by vinic alcohol, but instantaneously by methylic alcohol. If to 10 c.c. of vinic alcohol at 20° there is added 1 c.c. of the permanganate solution, twenty minutes are required before the liquid takes the yellow tint indicating complete reduction. If 10 c.c. of alcohol are used containing 1 c.c. of methylic alcohol the yellow tint is instantly obtained with potassium permanganate.

Note on Officinal Sodium Arseniate.—G. Fleury

Titration of Bismuth Subnitrate.—E. Baudrimont.—This process is based upon the facts that as 0·9074 grm. of monohydrated sulphuric acid correspond to 1 grm. anhydrous nitric acid these two weights of acids will require the same quantity of alkali for exact saturation, and that bismuth subnitrate is capable of yielding all its nitric acid to an excess of alkali on boiling.

Decomposition of Salts by Liquids.—A. Ditte.—The laws of dissociation by heat, applicable to the decomposition of salts by pure water and by saline or acid solutions, apply also to decomposition by alcohols.

The Spectroscope Applied to Chemical and Pharmaceutical Science.—M. Coulier.—The continuation of a long memoir incapable of abstraction.

Reproduction of Foot-marks in Criminal Cases.—A. Jaumer has devised a method for the better comparison of foot-marks with the shoes of a suspected person. M. Hugoulin had proposed to spread powdered stearine upon the soil previously heated to 100° (? How is this to be done without disturbing the ground !), when a crust is produced which solidifies on cooling. M. Jaumer now suggests to take a plaster-cast of the stearic crust.

Biedermann's Central-Blatt für Agrikultur-Chemie, July, 1880.

[The appearance of this issue has been delayed in consequence of the death of the editor.]

Influence of the Soil upon the Tannin of Oak Bark.—Dr. M. Fleischer.—A comparison was made between the bark of young oaks grown respectively upon sandy loams, upon a peaty soil which had been once burnt, and upon a similar soil thrice burnt. The proportion of tannin was found higher in case of the peaty soils.

The Performance of Manurial Experiments.—Dr. P. Wagner and Prof. G. Drechsler.—The authors find it necessary to treat several plots of land with each manure. Each experiment should be preceeded by a blank experiment to show the natural differences between the several plots. Not one, but several unmanured portions should be left in the field. Altitude and exposure should be perfectly alike. Each plot may be 10 acres = 1190 square yards in extent. To eliminate the effects of the weather the experiments should be repeated under identical conditions for several successive years.

Manurial Experiments on Peat-Soils.—MM. Waldner and Staubesand.

A Manurial Experiment on a Peaty Meadow.—M. Kirchoff.—A mixture named "potash-magnesia"—doubtless a Stassfurt product—gave the most remunerative result, and the same product mixed with superphosphate the worst.

Influence of Manures on the Appearance of Disease and the Proportion of Starch in Potatoes.—Prof. M. Märcker.—Three plots dressed with stable manure showed 6, 6, and 5 per cent of diseased tubers. Plots where superphosphate and small quantities of ammoniacal superphosphate were used did not increase the percentage, but with larger proportions of the latter it rose to 8 per cent. Chili saltpetre was attended by a proportion of 11 per cent, and when used as a top-dressing 12 per cent.

Manurial Experiments with Sugar-Beets.—Prof. M. Märcker.—Phosphoric acid, applied preferably in the spring, increased the yield of sugar most decidedly.

Influence of Borax on the Decomposition of Albumen in the Animal Organism.—Dr. M. Gruber.—The ingestion of borax is found to increase the decomposition of albumen.

Influence of Food upon the Secretion of Milk in Cows.—Dr. W. Fleischmann.

Methods for Freeing Lupins from Bitterness.—Dr. O. Kellner.—If lupins are swelled in water, allowed to freeze and rapidly thawed, their bitterness may be entirely removed by means of cold water.

Lupin Disease of Sheep.—Prof. F. Krocker.—The disease is ascribed to a fungoid growth in the lupins.

Influence of Uninterrupted Illumination upon Plants.—Prof. Schübeler.—The author's observations refer merely to the influence of the long summer days in high latitudes where flowers, fruits, &c., gain in intensity of colour and aroma, but from the want of heat are deficient in sweetness.

Hypochlorine in Plants and its Relations to the Chlorophyll Granules.—Prof. N. Pringsheim.

Function of Vegetable Vessels.—Prof. Jos. Böhm.—These two papers are of a botanical rather than of a chemical nature.

Comparative Analyses of Normal and Sprouted Sugar-beets.—H. Pellet.

Chemical Composition of Feeding-beets.—G. Janecez.

Process for Obtaining Sugar from Beet- and Cane-Juice, Treacle, and By-Products.—Prof. K. Löwig.—A patent process for obtaining sugar by means of colloidal aluminium hydrate.

Investigations on the Sap-quotients of the Sugar-Beet.—F. Sachs.

Occurrence of Vanilla in Raw Sugars.—Dr. E. v. Lippmann and Prof. C. Scheibler.—The authors have succeeded in isolating small quantities of vanilline from crude-sugar.

Two Processes for Purifying the Waste Water of Sugar Works.—W. Knauer, C. Tœlke, Dr. Bartz, and Dr. Sickel.—Knauer, after removing froth and suspended impurities and heating to 80°, precipitates with milk of lime, runs off the effluent, and adds a little manganous chloride. Drs. Bartz and Sickel report unfavourably on this process. Tœlke reduces the consumption of water as much as possible, lets it ferment and settle, and irrigates meadows with the water.

Colouring-matter of Grapes and Bilberries and the Artificial Colouring of Red Wines.—A. Andrée.—The colouring-matters of the blue grape and of the bilberry are identical.

Colouring-Matters of Wines.—A. Gautier.—From *Comptes Rendus*.

Analysis of Certain Beers.—A. Schrader.

Purification of Alcohol with Silver Nitrate.—J. E. Berlien.—A patented process.

Difficult Fermentation of Molasses.—M. Fiedler.

Influence of the Ventilation of Must upon Alcoholic Fermentation.—E. Rotondi.—The author considers that ventilation mechanically promotes the decomposition of the sugar, and acts also chemically, because the albumenoid bodies are transformed into more diffusible matters, and because oxygen by increasing the quantity of the ferment indirectly intensifies the fermentation.

Inferior Organisms Present in the Air.—E. C. Hansen.—The microscopic beings in the air are very unequally distributed. The germs of beer-yeast are not everywhere present. Bacteria are much less common than the moulds, such as *Penicillium glaucum*, *Mucor stolonifer*, &c.

The Best Temperature for Mashing and for the Formation of Sugar.—M. Rœhr.—The author found the transformation complete at 40° R. = 122° F.

Action of Salicylic Acid.—A. Schultz.—From the *Journal für Praktische Chemie.*

Die Chemische Industrie.

No. 9, September, 1880.

Chemical Industry at the Düsseldorf Exhibition, 1880.—Jos. Horadam.—A very complete account of the chemical manufactures of Westphalia, Rhenish Prussia, &c., which, it appears, employ 2266 workmen. The tar colour manufacturers of Crefeld, Höchst, &c., were not represented.

Attempts at the Manufacture of Sodium Ferrocyanide.—S. Tanatar.—From a number of experiments in which animal charcoal was ignited with compounds of potassium and sodium, and with various reducing agents, it appears that sodium compounds are capable of yielding cyanides. Experiments with a mixture of 10 parts animal charcoal with 25 parts sodium chloride and 5 parts sodium carbonate, or 25 sodium chloride, 5 sodium carbonate, and 3 calcium carbonate, to which 10 per cent of cast-iron turnings were added, gave good results. The separation of the sodium ferrocyanide from the melt is very difficult. The author concludes that the liberation of an alkali metal is not the cause of the formation of cyanogen, as it was produced in large quantities in mixtures, where an alkaline metal could not be liberated in appreciable quantities.—*Dingler's Pol. Journ.*, 237, p. 234.

No. 10, 1881.

Besides a long address by Prof. Klostermann on the influence of the protection of inventions, designs, and trademarks, in which the speaker falls into the error of asserting that the right of the patentee is created by law, this number is filled with abstracts of patent specifications and extracts from other journals.

MISCELLANEOUS.

"How is Petroleum to be Examined?"—The author's name is J. Skalweit, not F. Skalweit as printed in our number for February 18. We are requested to state that the little petroleum proof-apparatus is to be had at Hanover, at the office of G. Schnath, 8, Markt Strasse, Hanover, for 5 shillings.

MEETINGS FOR THE WEEK.

MONDAY, 14th.—London Institution, 5.
—— Medical, 8.30.
—— Royal Geographical, 8.30.
—— Society of Arts, 8. "The Scientific Principles Involved in Electric Lighting," Professor W. G. Adams, F.R.S.
TUESDAY, 15th.—Royal Institution, 3 p.m. "The Blood," Prof. Schäfer.
—— Civil Engineers, 8.
—— Society of Arts, 8. "The Diamond Fields of South Africa," R. W. Murray.
WEDNESDAY, 16th.—Society of Arts, 8. "The Compound Air-Engine," Col. F. Beaumont, R.E.
—— Meteorological, 7.
THURSDAY, 17th.—London Institution, 7.
—— Royal, 4.30.
—— Philosophical Club, 6.30.
—— Royal Institution, 3. "Ornament," Mr. H. H. Statham.
—— Chemical, 8. "On the Volumes of Mixed Liquids," F. D. Brown. "On Boron Hydride," F. Jones. "On the Action of Aldehydes on Phenanthraquinone in Presence of Ammonia," F. R. Japp and Edgar Wilcock. "On the Action of Benzoic Acid on Napthaquinone," F. R. Japp and H. J. N. Miller. "On the Alleged Formation of Nitrous Acid during the Evaporation of Water," R. Warington. "On the Absorption of Solar Rays by Atmospheric Ozone, and on the Blue Tint of the Atmosphere," Prof. Hartley. "Note on the Sweet Principle of Smilax Glycyphylla," C. R. A. Wright and E. H. Rennie.
FRIDAY, 18th.—Royal Institution, 8. "Musical Pitch," Dr. W. H. Stone, 9.
SATURDAY, 19th.—Royal Institution, 3. "American Humourists," Rev. H. R. Haweis.

TO CORRESPONDENTS.

Theophilus Pitt.—No accurate process is known.

PROF. ODLING'S CHEMISTRY FOR MEDICAL STUDENTS.

Now ready, a New Edition, Illustrated with 71 Woodcuts of Microscopical Preparations and Chemical Apparatus, price 6s.

A COURSE of PRACTICAL CHEMISTRY, arranged for the use of Medical Students, with express reference to the *Three Months' Summer Practice.* By WILLIAM ODLING, M.A., F.R.S., Professor of Chemistry in the University of Oxford. Fifth Edition, thoroughly revised.

London: LONGMANS and CO.

Recently published, price 6s.

A TREATISE ON FUEL: SCIENTIFIC AND PRACTICAL. By ROBERT GALLOWAY, M.R.I.A., &c.
The best methods of estimating the heating power of fuels, and the technical examination and analysis of the different varieties of coal are fully described; and among the illustrations, drawn to scale, are Siemens's Regenerative Gas Furnace, Pyrometer, &c., with complete descriptions.

By the same Author,

In the Press, and will be published immediately,

EDUCATION, SCIENTIFIC and TECHNICAL; or,
HOW THE INDUCTIVE SCIENCES ARE TAUGHT; and HOW THEY OUGHT TO BE TAUGHT.

London: TRÜBNER and CO., Ludgate Hill.

SOLAR PHYSICS.

The following Courses of Lectures will be given by Members of the Committee on Solar Physics, appointed by the Lords of the Committee of Council on Education:—

An Introductory Lecture. By Professor STOKES, Sec. R.S. 6th April, 1881.

A Lecture on the Practical Importance of Studying the Influence of the Sun on Terrestrial Phenomena. By Lieut.-General STRACHEY, R.E., C.S.I., F.R.S. 8th April.

Two Lectures on the Connection between Solar and Terrestrial Phenomena. By Professor BALFOUR STEWART, F.R.S. 27th and 29th April.

Six Lectures on Spectroscopy in Relation to Solar Chemistry. By Mr. J. NORMAN LOCKYER, F.R.S. 4th, 6th, 11th, 13th, 18th, and 20th May.

Three Lectures on the Photography of the Infra-red of the Spectrum in its Application to Solar Physics. By Captain ABNEY, R.E., F.R.S. 25th and 27th May and 1st June.

The Lectures will be delivered in the Lecture Theatre of the South Kensington Museum, at 4 p.m., on the days stated above.

Admission will be by Tickets, which may be obtained, as far as there is room, on application by letter to the Secretary, Science and Art Department, South Kensington, S.W.

BERNERS COLLEGE of CHEMISTRY.

Instruction and preparation in CHEMISTRY and the EXPERIMENTAL SCIENCES under the direction of Professor E. V. GARDNER, F.A.S., M.S.A.

The Class Rooms are open from 11 to 5 a.m. and from 7 to 10 p.m daily.

Especial facilities for persons preparing for Government and other examinations.

Private Pupils will find every convenience.

Analyses, Assays, and Practical Investigations connected with Patents, &c., conducted.

Prospectuses and full particulars on application to Prof Gardner at Berners College, 44, Berners-street W.

AMMONIACAL LIQUOR.

THE DIRECTORS OF THE BRISTOL UNITED GAS LIGHT COMPANY invite TENDERS for the PURCHASE of the AMMONIACAL LIQUOR made at all or either of their THREE STATIONS, situate respectively at AVON STREET, CANONS' MARSH, and STAPLETON ROAD in the Borough of Bristol, for a TERM of FIVE or SEVEN YEARS, commencing on 1st JULY, 1882.

The Annual Quantity of Liquor produced at present at the three Stations is about 2¼ millions of gallons.

Conditions of Contract and other particulars may be obtained of e SECRETARY, at the Office of the Company, Canon's Marsh, Bristol.

Tenders to be delivered on or before TUESDAY, 3rd day of May next, addressed to the Chairman of the Company, and marked 'Tender for Ammoniacal Liquor."

The Directors do not bind themselves to accept the highest or any Tender.

HENRY H. TOWNSEND, Secretary.

Gas Offices, Canons' Marsh, Bristol,
8th January, 1881.

MOTTERSHEAD & CO.,

7, Exchange Street and 10, Half Moon Street,
MANCHESTER.

CHEMICAL & PHYSICAL APPARATUS, BOTTLES, PURE CHEMICALS,

REAGENTS, STANDARD SOLUTIONS,
And Every Requirement for Works' or School Laboratories or Private Students.

Illustrated Price Lists on application.

MR. J. S. MERRY,

ASSAYER AND ANALYTICAL CHEMIST,
SWANSEA.

SPECIALITIES.

MANGANESE—Finest Crystallised, Lump, Ground, and Granulated of every quality, and Prepared for *Chlorine, Glass, Steel, Ferro-Manganese Pottery, Battery,* and Every Purpose.

BAUXITE—(Hydrate of Alumina) Of high percentage of Alumina and almost free from Iron The Cheapest, Best, and Most Profitable article from which to produce Alum, Alum Cake, and Sulphate of Alumina, &c.
[BRAND, "IRISH HILL BAUXITE."]

FLUOR-SPAR—Of the Very Finest Quality for Acid, Soda, Glass Flux, and all purposes

BARYTES—(Carbonate and Sulphate. Crystallised, Selected Lump and Ground for all uses.

CRYOLITE—Magnesite, Felspar, Arsenic, Phosphates, French Chalk, Strontia, Wolfram, Chrome, Terra Alba, Rotten Stone, China Clay, Umbers Ochres, Antimony, Calamine, Emery Stone all Oxides, and all

FULLER'S EARTH—Of superior quality, and entirely free from grit. [BRAND, "EMERALD."]

MINERALS, CHEMICALS, AND COLOURS.

GEO. G. BLACKWELL,

MINE PROPRIETOR,
Manganese and Mineral Works, Grinding Mills, and Ore Yards, GARSTON.
OFFICES—26 CHAPEL STREET LIVERPOOL.

WILLIAM AND WILLIAM T. FIELD,

MANUFACTURERS of the Celebrated STAFFORDSHIRE BLUE BRICKS, specially adapted for Chemical Plant, *i.e.*, Acid Towers, &c. Also all other kinds of Best Staffordshire Blue Bricks, Pavings, Plynths, Splays, Copings, &c. &c. Prices and samples on Application.

TESTIMONIAL

"We have used the Blue Staffordshire Brick or Sulphuric Acid Towers, &c., manufactured by Messrs. Field, for the last fifteen years during which time they have given great satisfaction. We recommend them to the Chemical Trade, believing there is nothing better in the market."—(Signed) WILLIAM HUNT and SONS, Lea Brook Alkali Works, near Wednesbury, Staffordshire, February, 1878.

TOLL END BRICK-WORKS,
TIPTON, STAFFORDSHIRE.

TETRACHLORIDE OF CARBON.
BISULPHIDE OF CARBON.
CHLORIDE OF SULPHUR.

JESSE FISHER & SON,
Phœnix Chemical Works Ironbridge.

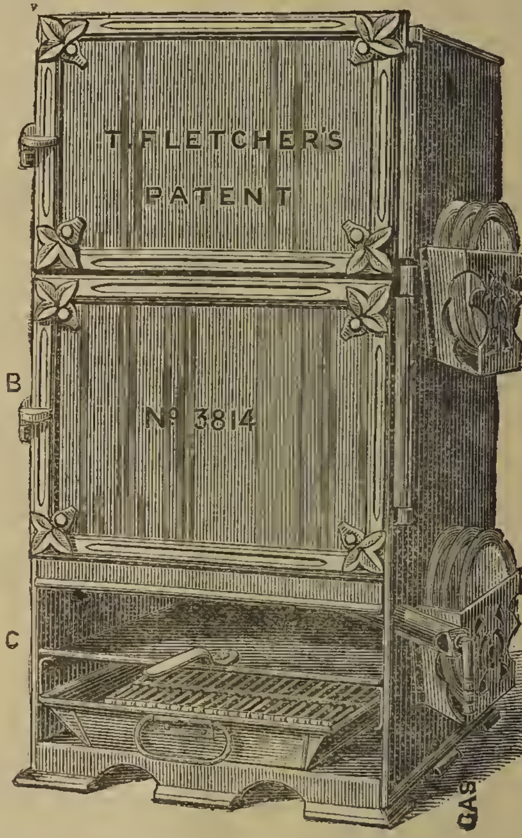
Water-Glass, or Soluble Silicates of Soda and Potash, in large or small quantities, and either solid or in solution, at ROBERT RUMNEY'S Ardwick Chemical Works, Manchester.

FLETCHER'S

PATENT VENTILATED

HOT-AIR OVEN.

At a cost of less than one halfpenny per hour for gas, this oven will grill, roast, toast, bake, warm dishes and plates; and with the assistance of Fletcher's Patent Solid Flame Boiling Burners will do everything possible with a first rate open fire (except drying clothes on washing days).



It is unapproached by any oven for pastry, and is fully hot in one minute after the gas is lighted.

Fish, joint, and pastry can be cooked all at once, in the most perfect manner, without the slightest taint from one to the other. The cooking is always good and always alike.

It will roast joint and fowls both at once, at least as well as an open fire.

Complete illustrated list of gas cooking and labour saving appliances free by post. List of Gas and Petroleum Laboratory Furnaces and Apparatus, price 2d.

THOS. FLETCHER,
4 & 6, MUSEUM STREET, WARRINGTON.

BISULPHITE OF LIME.
BISULPHITE OF SODA.
SULPHITE OF SODA. TANNATE OF SODA

WILLIAM MARRIOTT
CHEMICAL WORKS HUDDERSFIELD

THE CHEMICAL NEWS

AND
JOURNAL OF PHYSICAL SCIENCE.

Edited by WILLIAM CROOKES, F.R.S.

Published every Friday. Price 4d. Annual Subscription, post free including Indices, £1

CHARGES FOR ADVERTISEMENTS.

	£	s.	d.
Five lines in column (about 10 words to line)	0	3	6
Each additional line	0	0	6
Whole column	1	15	0
Whole page	3	0	0

A reduction made for a series of insertions.

Cheques and Post-Office Orders, crossed "London and County Bank," payable to the order of William Crookes.

BOY COURT LUDGATE HILL LONDON, E.C

THE CHEMICAL NEWS.

Vol. XLIII. No. 1112.

ON THE SOLUBILITY OF SULPHUR DIOXIDE IN SULPHURIC ACID.*

By J. T. DUNN, B.Sc.

Some time ago, I had occasion to make some experiments in which sulphur dioxide, the volume of which it was necessary to measure, was evolved in contact with strong sulphuric acid. The results were very discordant, and differed amongst themselves in a way which I could only explain by supposing that the gas had dissolved in the acid, and that varying quantities had been taken up in the different experiments.

I could not find any information on the subject in the usual books of reference, but a simple experiment showed that the solubility of SO_2 in oil of vitriol was quite appreciable. I filled a graduated tube with dry SO_2 over mercury, and with the help of a pipette passed up a small quantity of concentrated sulphuric acid. There was an immediate rise of liquid in the tube, and the absorption continued at a decreasing rate for about three days, at the end of which time the level of the liquid in the tube was tolerably constant, even after agitation. The original volume of gas (reduced to normals) was 61·5 c.c., and the residual gas after absorption 27·5 c.c., so that 34 c.c. had been absorbed by the quantity of acid used, 10 c.c. The tension of the gas at the end of the experiment was about 506 m.m., so that this very rough determination would give as the absorption coefficient of SO_2 in sulphuric acid at 14° C. and 760 m.m., about 5·1.

I was curious to know whether the coefficient determined in this rough way would be any approach to the actual solubility, because the experiments to which I have referred above rather led me to think that the amounts of gas dissolved by being simply confined in a tube over H_2SO_4 might vary within very wide limits; and I therefore proposed to myself to determine the solubility with some degree of accuracy.

The solubility not being extremely small, I determined it in the first instance directly, by the increase in weight of a known volume of H_2SO_4 when saturated with gas. The SO_2 was prepared in the usual way from copper and sulphuric acid, and was carefully dried by first bubbling through strong sulphuric acid in a washbottle, and then passing over about 2 feet of sulphuric-acid-pumice. The acid used to absorb the gas was pure re-distilled acid, having a specific gravity of 1·840 at 15° C. It was contained in a test-tube fitted with a cork which carried the entrance and exit tubes for the gas, and a thermometer; the volume of this apparatus was known. The test-tube having been weighed before and after the introduction of the sulphuric acid, the volume of the latter was calculated from its weight. SO_2 was passed through the apparatus for about three hours, the exit tube being connected with a guard tube of calcic chloride to prevent the sulphuric acid picking up moisture from the outer air, and the absorption apparatus being immersed in water to secure approximate constancy of temperature. The temperature and pressure were now observed, and the apparatus reweighed. The space above the acid in the test-tube, which originally contained air, was at the end of the experiment of course full of SO_2, and a deduction had to be made on this account, the amount of which was easily calculated when the volume of acid and the total volume of the apparatus were known. The following are the figures obtained:—

Weight of H_2SO_4	33·1857	grms.
Volume at 15° C.	18·036	c.c.
Weight of SO_2 absorbed	1·4184	grms.
Volume at normals	494·67	c.c.
Temperature	17° C.	
Barometer	742·4	m.m.
Observed coefficient of absorption	27·49	
Coefficient at 760 m.m.	28·14	

I satisfied myself that the acid was saturated, by replacing the apparatus, and passing the gas for another hour, when no increase in thd coefficient was given.

A second similar experiment gave as the coefficient of solubility at 16 C., the figure 28·86, which agrees very well with the first.

It will be seen that the solubility determined in this way is more than five times as great as that deduced from the first rough experiment above-mentioned, and this shows that even prolonged contact of the gas with the absorbent (for after the third day, when the measurements were taken, they were left in contact in the tube for three weeks without a measurable increase in the absorption) is not in all cases sufficient to insure even an approach to saturation.

After I had made these determinations my attention was drawn to a table in Dr. Lunge's treatise on "Sulphuric Acid and Alkali," vol. i., p. 29, wherein are given the following solubility-coefficients for acids of different strengths:—

Sp. gr.	Litres of SO_2 dissolved. Per litre acid.
1·841	5·8
1·839	8·9
1·540	11·2
1·407	15·9
1·227	29·7
1·000	49·0

It is not stated whence these results are derived, by what method they were obtained, nor the temperature at which they were taken. From the figure for water, however, it is evident that the temperature must be about 15° or 16° C., and if that is the case for all the results, the figures for acids of 1·841 and 1·839 sp. gr. differ enormously from those which I have obtained for acid of 1·840. In the absence of information as to the methods employed, it is useless to speculate on the cause of such a discrepancy; but it is worthy of remark that the figures (5·8) for acid of 1·841 sp. gr. is not far removed from that (5·1) given by my trial experiment with the graduated tube.

I have made a number of determinations by another method, with the view of ascertaining the influence of temperature and strength of acid on the solubility; these are not yet complete, but as far as they have gone they have established the fact that at 84° C. the coefficient for acid of 1·840 sp. gr. has diminished to 4·5, and have confirmed the coefficients already given for temperatures about 16°.

---

* A paper read before the Newcastle-upon-Tyne Chemical Society, January 27, 1881.

THE ACTION OF SEA-WATER UPON CAST-IRON.*

By A. LIVERSIDGE,

Professor of Geology and Mineralogy in the University of Sydney.

The specimen forming the subject of this note was obtained from the screw of the dredge *Hunter* employed in Newcastle Harbour, New South Wales.

Mr. Moriarty, the Engineer-in-Chief for Harbours and Rivers, tells me that the dredge had not been wrecked as I had previously been informed—in fact she is still at work; but that the screw became so rotten as to necessitate its

---

* A Paper read before the Royal Society of New South Wales, September 1, 1880.

removal. He accounts for the rapid decay, and very sufficiently, by the iron having been in actual contact with the copper sheathing of the vessel. In the same letter Mr. Moriarty mentions that an old iron cannon was taken up from the foul waters at the head of Darling Harbour, where it had lain for some twenty years, but the corrosion had only eaten its way into about $\frac{1}{16}$ of an inch.

Even on the most cursory examination the specimen is seen to differ entirely from the original cast-iron, except in form, which seems to be unchanged; the material, however, is so altered in composition that it may be safely described as a pseudomorph, since it is almost entirely made up of oxide of iron and particles of graphite. It is quite sectile, being readily cut with a knife; the powder under the microscope presents a mixture of brilliant scales of graphite, mixed with brown-coloured oxide of iron and a few widely scattered minute particles of metallic iron; these on removal by means of a magnet answer to all the tests for metallic iron, and flatten out with a bright metallic lustre when ground in an agate mortar.

In colour the external part of the specimen is of a dull grey, within it is of a rusty brown colour, with darker bands which follow more or less closely the outer contour lines.

Different portions of the mass apparently vary somewhat in composition; the portion taken for examination was purposely chosen from the innermost part, as it appeared to be firmer and less friable that the very outside of the specimen; but even this only contained 0·04 per cent of metallic iron; the boss of the screw was, I understand, only superficially acted upon; the part examined by me came from one of the blades. On analysis it was found to have the following composition:—

Carbon	68·73
Iron protoxide	23·23
Iron sesquioxide	1·79
Iron, metallic	0·04
Manganese	0·62
Phosphorus	absent
Sulphur	traces
Silicon	5·59
	100·00

The specific gravity at 62° F. taken upon a piece weighing 58·405 grms. was found to be but 1·63.

The carbon was not estimated directly, partly on account of the difficulty of satisfactorily determining its amount by the combustion process, and partly because, after everything else had been determined, it was thought that the amount of carbon could be estimated with sufficient accuracy by taking the difference.

The silicon was estimated in the form of silica by fusion with the mixed carbonates of potash and soda, the carbon being burnt off by the addition of potassium chlorate; the residue was extracted with boiling water, the silica rendered insoluble and determined in the usual way.

The metallic iron was extracted by means of a magnet, treated with fuming nitric acid, to get rid of attached impurities, washed, dissolved in hydrochloric acid, and estimated volumetrically.

It is interesting to note that the phosphorus has been eliminated completely by the action which has gone on, and that the amount of sulphur is quite small; for both were probably present in the original cast-iron.

Several instances of the effects produced by sea-water acting upon cast-iron are quoted by Gmelin in his "Handbook of Chemistry," vol. v., p. 218. These are also referred to in Watts's "Dictionary of Chemistry," vol. iii., p. 331, but no additional cases appear to be cited in the latter work, although published in 1871, *i.e.*, twenty years later. The instances quoted are the following:—

"Certain cannon-balls out of a number which had lain for forty-two years under sea-water were found to be converted into a substance like plumbago, some to the distance of half an inch, others to the very centre."—(*Sill. Amer. Jour.*, 4, p. 178.)

"Some cannon-balls lying in the sea on the coast of Norway since 1692, had retained their form and bulk, but had lost two-thirds of their weight, yielded to the knife, did not act upon the magnet, and were free from metallic iron (Deslongchamp, J., *Chem. Med.*, 13, p. 89)."

"Cannon-balls raised at Carlscrona from a sunken vessel, lost fifty years previously, were found to be changed through one-third of their thickness into a porous graphitic mass, which became strongly heated when exposed to the air for a quarter of an hour; in fact, so hot as to drive the water off in steam."—(*Berzelius Lehrb.*)

Dr. Percy, F.R.S., lately Professor of Metallurgy at the Royal School of Mines, in his volume on the metallurgy of iron and steel, quotes some instances collected by Henry Wilkinson in his work "On the Extraordinary Effects Produced on Cast-iron by the Action of Sea-water," 1841. Amongst them he gives the following:—"Many of the vessels of the Spanish Armada were sunk off the shore of Mull in Scotland, and in 1740 some of the guns of a vessel named the 'Florida' were raised. These were both brass and cast-iron guns, and on scraping the latter, which were deeply corroded, they became so hot that they could not be touched. However, they lost this property after two or three hours exposure to the air, and there was no difference in the appearance of the substance before and after the combustion." "In a naval engagement with the French at Portsmouth in 1545, the *Mary Rose* of the English Fleet was so overweighted with ordnance that she sank with all her crew of nearly 600 men, On the 16th June, 1836, a 24-pounder brass gun, 11 feet in length, belonging to this vessel, was raised with the aid of diving apparatus. This gun had a cast-iron shot in it, which on exposure to the air, is stated, became nearly red-hot and fell to pieces." "At the same time," Mr. Wilkinson writes, "four brass and three iron guns were raised from the wreck of the *Mary Rose*. The iron guns were of the ancient description, formed of iron bands hooped together with iron rings, and they were all loaded, but the guns being made of wrought or malleable iron did not exhibit the same phenomena as the balls, which were made of cast-iron. Those balls, which by their diameter ought to have weighed 30 lbs., were reduced to 19 lbs. 3 ozs. The 8-inch or 70-lb. ones were only 45 lbs., and although to external appearance, the same as regular shot, they fell to pieces *red-hot* on exposure to the air."*

No complete analyses seemed to have been made of the graphite-like residues; hence no comparison could be made between the composition of this specimen from the "Hunter" and that of others.

Dr. Percy refers to some experiments made by Professor Daniell.† A cube of grey cast-iron was acted upon by dilute hydrochloric acid. When the acid was saturated the cube was taken out and found to consist of a soft spongy substance, but apparently undiminished in bulk. A specimen of white cast-iron having a radiated fracture was similarly treated; the dark grey spongy residuum could be easily cut with a knife and resembled plumbago. Some of it when placed to dry on blotting-paper spontaneously heated and smoked in the course of a minute. In another case when a considerable quantity of it had been heaped together it ignited and scorched the paper.

But the most valuable contributions to our knowledge upon this subject were made by Mr. Robert Mallet, F.R.S., in his Reports to the British Association for the years 1838, 1840, and 1843. These reports were made at the request of the British Association, and they contain the results of a most careful and elaborate series of experiments made to ascertain the action of sea and river water, both clear and foul, and at various temperatures, upon many hundred specimens of cast and wrought iron and steel, as well as to test the advantages of various protective paints and varnishes; they also contain the results of experiments made to ascertain the protection afforded by zinc, &c., to iron structures in contact with water.

---

* Percy's "Iron and Steel," p. 147.

† Percy's "Iron and Steel," p. 146, quoting from the *Journal of Science and Art*, vol. ii., p. 278.

Mr. Mallet mentions a case[*] in which bars of cast iron 3-inches broad and 1-inch thick, which formed protectors to the copper of a vessel, to the amount of about $\frac{1}{100}$ of its surface, were in a voyage of not quite five months to Jamaica and back, converted into plumbago to the depth of half an inch; this statement is of special interest in connection with the specimen from the *Hunter*.

Mallet states that Priestley was one of the first of those who observed this conversion of cast-iron into a plumbago-like mass of mixed oxide of iron and carbonaceous matter, and that such residues frequently but not invariably became hot or spontaneously inflammable on exposure to the air. Mallet states that under certain circumstances even the purest malleable iron iron is converted into this plumbago-like substance, and quotes instances. The same writer mentions that some cannon-balls which were found in the sea near the site of the battle of La Hogue had, after an immersion of 145 years, been converted into plumbago to the depth of an inch in some cases and right through in others; and assuming their diameter to have been about 6¼ inches, the usual size of 32-lbs. shot, he points out that the iron had been destroyed to a depth of 3⅛ inches during the above number of years,—a much more rapid rate of action than he obtained from his special experiments.

The foregoing will probably suffice as instances of the action of sea-water, brought about more or less by accident. Mr. Mallet's experiments are far too numerous to quote here—I can merely give a bare summary of his results.

Mallet found that the approximate depth of corrosion in clear sea-water at the end of one century would be as follows:[†]—

Welsh cast-iron.	Hot and cold blast	0·306 inch.
Irish ,,	Cold	0·306 ,,
Mixed cast-irons; Scotch and Welsh, Irish and Welsh, &c.,..		0·337 ,,
Scotch cast-iron.	Chiefly hot blast	0·379 ,,
Staffordshire, Shropshire, and Gloucestershire cast-iron.	Hot and cold blast ..	0·385 ,,
Grey cast-iron, mixed.	Skin removed by planing	0·419 ,,
Derbyshire and Yorkshire cast-iron.	Hot and cold	0·431 ,,
Wrought-iron.	Standard bar, No. 2 Dowlais	0·543 ,,

In another table[‡] he gives the approximate depth of corrosion for the following wrought-irons and steels at the end of one century in clear sea-water, foul sea-water, in clear fresh water, and when freely exposed to the weather in Dublin:—

	Clear Sea-water. Inch.	Foul Sea-water. Inch.	Clear Fresh-water. Inch.	Exposed to the Weather in Dublin. Inch.
Red-short bar, Staffordshire	0·276	0·644	0·032	0·335
Common bar, Shropshire	0·927	0·434	0·081	0·540
Best bar, Staffordshire	0·316	0·423	0·039	0·361
Best Welsh bar, Dowlais	0·278	0·638	0·035	0·353
Low Moor boiler plate	0·215	0·404	0·035	0·332
Common boiler plate	0·272	0·554	0·038	0·412
Swedish bar, Danemora	0·277	0·726	0·030	0·470
Fagoted scrap bar..	0·064	0·379	0·024	0·219
Blister steel bar, soft	0·298	0·425	0·015	0·301
Shear steel bar, soft	0·313	0·676	0·025	0·389
Cast steel, tilted bar, soft	0·441	0·559	0·026	0·279
Cast steel, tilted bar, hard	0·239	0·430	0·043	0·156

As in the former table the results were obtained from specimens which had been immersed for 732 days.

Mallet found that the corrosion of cast-iron, which has had its skin removed by planing, is precisely the same in moist air as in clear sea-water, also that the rate of corrosion of cast iron in sea-water is a decreasing one, when the coat of plumbago and rust first formed is removed prior to a second immersion. When the coating is untouched the corrosion goes on at a nearly uniform rate. The coating of plumbago and rust is negative to the metal; hence, when left on, it assists in the corrosion of the metal; in fresh-water this is not so strongly marked, since the coating is harder and less porous; thus to a greater extent it mechanically defends from corrosion.

The rapid action of sea-water upon cast-iron and the commoner varieties of wrought-iron is probably due mainly to the local galvanic action set up between the diffused scales of graphite, films of slag, or other foreign matter.

Where cast-iron is exposed to the combined action of fresh-water and of sea-water, as at the mouths of rivers, the action is said to be much more rapid, for the heavy sea-water remains below while the lighter fresh-water floats above, thus producing a voltaic pile having two liquids and one solid, also in places where the sea-water is foul and more or less contaminated with sulphuretted hydrogen.

The action of acid waters in copper and other mines, and of solutions of the salts of copper upon iron is well known, and it is taken advantage of by the miner in the humid or precipitation processes for the extraction of copper. It is quite a common thing for workers in certain mines to find neglected articles of cast-iron which have been exposed to the action of "acid" waters converted into masses of graphite-like matter.

The action of sea-water upon iron, and especially upon cast-iron structures, must be one of very great interest and importance to engineers; it is certainly one well worthy of further investigation, especially in connection with the construction of cast-iron cylinders for the support of piers and wharves in harbours and estuaries. The copper sheathing of ships and the metal of cast-iron wharves would form a galvanic couple if connected in any way either by actual contact, by wet hawsers, fenders, or by other means affording a passage for the electric current.

Mallet refers to the well known rapidity with which recently made castings become coated with rust when exposed to a shower of rain, and he states that it takes place much more rapidly in the case of castings made in "dry sand" or "loam" than in those made in damp or "green sand" moulds. He says, "in 'loam' or dry sand moulds, moisture not being present, but little hydrogen is generated by the fluid metal to burn off the 'facing' of charcoal which remains '*parsemé*' on the surface of the casting, producing innumerable voltaic couples in contact with water; while in the case of the 'green sand' castings, most of the charcoal facing is removed in a gaseous form from the casting before it leaves the sand." But I am inclined to think that this difference is probably due in part, if not wholly, to the formation of a film of magnetic oxide of iron by the steam from the moisture: the protective action of such a film has long been known, although it was not made use of on a large scale until Mr. Barff, the Professor of Chemistry at the Royal Academy, brought out his process.

Liverpool College of Chemistry.—This institution, which was founded in 1848 by the late Dr. Sheridan Muspratt, has apparently been for some time in abeyance. It has now, however, been re-opened by Drs. Tate and Granville H. Sharpe, and bids fair to enter upon a career of usefulness. We learn that the laboratories have been enlarged and refitted in accordance with modern requirements and present every facility for research, for the execution of commercial analyses and assays, and for instruction in chemical science. We cordially hope that the college may prove a focus of sound and thorough-going work.

---

[*] "British Association Report," vol. viii., 1838, p. 262.

[†] "British Association Reports," 1840, vol. x., p. 299.

[‡] "British Association Reports," vol. xiii., 1843, p. 53.

ANALYSES OF SOME GEYSER DEPOSITS.

By HENRY LEFFMANN, M.D.

The following analyses are submitted as a contribution to the chemistry of the interesting region known as the Yellowstone National Park. The phenomena of geyser action are seen in great extent and variety in this region, and the chemical characters of the waters and deposits are important points in studying the geology and physical geography. I am indebted to Dr. A. C. Peale, of the U.S. Geological Survey of the Territories, for the specimens. They were all collected by him in 1878. I expect, before long, to submit further interesting results in regard to these deposits.

1. From Black Sand Geyser in Upper Geyser Basin.—Hardness 6·5 to 7·0; sp. gr. 2·08. A slightly stratified mass of mixed white and flesh colour giving much the appearance of felspar.

Silica	94·0
Alumina and ferric oxide	1·0
Water	5·3
	100·3

2. From Yellow Crater Spring in Shoshone Geyser Basin.—Compact white mases distinctly stratified. Hardness 6·5 to 7·0.

Silica	94·0
Alumina and ferric oxide	traces
Lime	0·1
Water	5·2
	99·3

3. From Witch Creek in Heart Lake Geyser Basin.—Snow-white masses stained by iron oxide in spots. Not stratified. Hardness 7·0.

Silica	94·1
Water	1·0
Alumina, &c.	not determined

4. Geyserite from Pearl Geyser in Gibbon Geyser Basin.—Porous and slightly greyish masses; upper surface smooth and finely mammillated. Hardness 6·0.

Silica	87·1
Water	10·6
Alumina, &c.	undetermined

5. Pebble of Geyserite from basin or bowl of Rustic Geyser, Heart Lake Geyser Basin.—Double convex greyish white mass, evidently rolled by water. Hardness 5·5.

Silica	90·0
Alumina and ferric oxide	2·6
Lime	1·6
Water	5·0
	99·2

6. Geyserite from Deluge Geyser, on Witch Creek, Heart Lake Geyser Basin.—Clay-like fawn coloured moss; upper surface with numerous stalactitic projections. Hardness 5·0.

Silica	19·0
Water	8·0
Alumina, &c.	undetermined

7. From Rustic Geyser, Heart Lake Geyser Basin. Masses resembling drusy quartz.—The water from this geyser coats wood, and one of the specimens of the deposit encloses a piece of wood. Hardness 5·5 to 6·0.

Silica	87·3
Alumina with traces of iron	2·2
Water	10·3
	99·8

The above minerals represent two sub-species of the quartz group. Nos. 4, 5, 6, and 7 are *geyserites*, distinguished by the eight to ten per cent of water (No. 5 is exceptional), and not over 90 per cent of silica. Nos. 1, 2, and 3, show less than 6 per cent of water and about 94 per cent of silica. A specimen of this composition was first analysed by Dr. F. M. Endlich, and reported by him in the "Report of the U.S. Geological Survey for 1872," page 153. To this variety the name *Pealite* has been given in honour of the collector.

920, Walnut Street, Jan. 31, 1881.

ON THE RELATIONS BETWEEN THE ATOMIC WEIGHTS.

The hypothesis of Prout, according to which the atomic weights of the elements are exact multiples of the atomic weight of hydrogen = 1, has been long ago shattered by the researches of Schützenberger. By means of careful investigations and the application of trustworthy methods, a series of atomic weights have been determined on comparing which it would be in vain to search for a common factor. But there are certain relations between the atomic weights of the elements of one and the same group, as was pointed out by Dumas, and which have been more closely examined by Gerber. He finds for the monatomic elements the common factor 0·769, for the oxygen and magnesium group, as also for carbon, silicon, and certain other elements, the factor 1·995; for the nitrogen group along with boron, bismuth, and gold, 1·559, and for the other metals 1·245. These factors are purely empirical, without mutual relation, and in themselves of no value. Whether the detection of such numerical relations will be of real service to chemical research must remain undecided.—*Chemiker-Zeitung.*

THE ALKALOID FROM PITURIE.*

By Professor LIVERSIDGE, Assoc. R. S. Mines, F.I.C.

I am indebted to the kindness of Mr. de Renzie Wilson, of Bangate Station and the Retreat, Barcoo River, for the supply of piturie upon which this investigation was conducted, also to other friends who placed some smaller quantities at my disposal. Mr. Wilson had considerable difficulty in procuring a sufficient supply for my purpose; he states that the blacks prize it very highly; so much do they value it that it can only be obtained from them in very small quantities at a time, hence it involves the expenditure of much time and trouble to collect together a few pounds weight of the substance. The blacks in his district on the Barcoo obtain it from the Diamantina blacks who trade yearly with the Mulligan or Kykockodilla tribe, in whose country the piturie grows. One parcel which Mr. Wilson sent to me was some months in transit, as it had to be carried down on camels to Port Augusta; the sea journey from Port Augusta to Sydney was of course a question of only a few days.

The first parcel of piturie was in the form of broken twigs, and fragments of leaves of a pale brown colour, emitting a smell somewhat similar to tobacco; the fine dust causes sneezing. This is its usual state, but the second parcel forwarded by the camels was much less broken up and was of a darker colour, the difference being probably due to the less careful drying which it had undergone, for, as Mr. Wilson explained in his letter, the camels started earlier than was expected, and in consequence the piturie had to be packed up before it was thoroughly dried.

Unfortunately none of the samples contained either flowers or seeds, but I have but little doubt that the piturie

---

* A Paper read before the Royal Society of New South Wales, November 3, 1880.

supplied to me was obtained from the plant *Anthocercis Hopwoodii*, since known as *Duboisia Hopwoodii*;[*] (F. v. M.), and now named *D. Pituri* by Dr. Bancroft;[†] one of the Solanaceæ.

Dr. Bancroft gives the following description of the piturie plant:[†] "The piturie grows about 50 miles east and west of the 138° meridian, the boundary between Queensland and South Australian territory, and from 22° to 25° south latitude. It is a shrub or small tree about 8ft. high, with a stem at the thickest part at times as much as 6 inches in diameter. Wood light, close-grained, lemon-coloured, with a smell of vanille when newly cut. Suckers spring up around the tree, from long, rough roots spreading near the surface. Leaves 3 to 3½ inches long, pointed at both ends, ¼ inch wide, mid-rib distinct, margin slightly recurved; flower, a funnel-shaped tube, from ¼ to ⅜ of an inch long, with five bluntish divisions, spreading to about ¼ inch across. Three reddish lines run from each division down the throat of the flower, as in the genus *Myoporum*, which latter may be known by having four or five stamens of equal length. The pistil of the pituri extends to the length of the two longer stamens. Stamens four, two long and two short; anthers, yellow, kidney-shaped, filament attached to the concave side, the anther bursting along the convex margin; best seen by examining a flower that is just at the point of opening. Fruit, a green berry resting in the minute calyx. As it ripens it changes to black, and contains dark-brown kidney-shaped seeds, covered with minute pits, recognisable by the aid of a pocket lens. Ripe berries soon fall off, and should be looked for under the tree, as those gathered from the branches are not mature enough to germinate."

Mr. Wilson informs me that the blacks mix the piturie with the ashes of the leaves of a particular plant and usually roll the mixture up with a green leaf into the form of a quid before chewing; the addition of the wood ashes is doubtless made for the same reason that lime is mixed with betel by the Malays and others, namely, for the purpose of slowly liberating the alkaloid during the process of mastication. The quid or bolus is, on ceremonial occasions, said to be passed from native to native, each one masticating it for a time, and then passing it on, it finding a resting place behind the original proprietor's ear until again required.

The effects of the piturie seem from all acounts to be very much the same as those set up by tobacco-smoking; it does not appear to have the exciting effect upon the blacks with which it was at one time credited. As is the case with other luxuries, it is reserved by the older men for their own use exclusively, neither women nor young men being allowed to use it. The reasons for using it appear to be much the same as those which induce white people to smoke and in certain cases chew tobacco.

I have made no attempts to experiment upon the physiological effects of the alkaloid, since this part of the subject has been very fully treated by Dr. Bancroft and other observers. The examination was made mainly with the view to ascertain its chemical composition, and, if possible, constitution. The supply of alkaloid was insufficient to admit of both questions being treated.

In a letter dated September 5, 1879, the Baron von Mueller, K.C.M.G., has been kind enough to place at my disposal the following account of the alkaloid obtained by him from piturie, which is the substance of a paper of his read before the Apothecaries' Society of Vienna:—

"For the preparation of piturine and pituric acid the branchlets and leaves of *Duboisia Hopwoodii*, F. v. M., were subjected to exhaustion by boiling water, the infusion evaporated to honey thickness, then mixed with three volumes of alcohol, the resulting solution evaporated to the consistence of an extract, the latter dissolved in water and precipitated by basic acetate of lead. The precipitate separated by filtration contained a peculiar acid substance, while the filtrate, after sufficient concentration and after mixing with an excess of caustic soda solution and ether, yielded to the latter the alkaloid which was purified by agitating its etherous solution with diluted sulphuric acid, thereby forming the sulphate of piturine. The aqueous solution of the latter was then again decomposed by caustic soda, the pure alkaloid removed by ether, and the solution evaporated at a gentle heat. It formed a brownish liquid of oil-like thickness, heavier than water, of acrid and burning taste and tobacco odour, much affecting the organs of sight and respiration. It is volatile and forms fogs with diluted hydrochloric acid, is of strong alkaline reaction, and combines thoroughly with acids.

"Its hydrochloride forms precipitates with the chlorides of platinum and gold, with picric and tannic acids, phosphomolybdate of soda, bi-iodide of potassium, the iodide of potassio-mercury and potassio-bismuth, also with phosphowolframate of soda,[*] but this precipitate is easily dissolved in an excess of this reagent. Piturine mixes with every proportion of water, alcohol, and ether. Concentrated hydrochloric and nitric acids do not affect a colouration with it; concentrated sulphuric acid forms reddish-brown clouds and dissolves to a brownish-green liquid. The yield was about 1 per cent of alkaloid from the dried plant.

"Piturine is in some respects allied to nicotine, but more closely akin to the duboisine of *Duboisia myoporoides* (R.Br.), the latter being of lighter colour, of bitter not acrid taste, of fainter odour, less irritating to the eyes and respiratory passages; its hydrochloride in solution is not precipitated by chloride of platinum, but is so by phosphowolframate of soda, and the precipitate is not re-dissolved by a superabundance of that reagent."

A. Ladenburg, *Comptes Rendus*, 1880, vol. 90, p. 874 to 876, however, states that the alkaloid of *Duboisia myoporoides* is identical with hyoscyamine, and that it crystallises in small needles, fusing at 108·5° C., and is isomeric with atropine, from which it is distinguished by forming a brilliantly lustrous compound with gold chloride, fusing at 159° C. Also when treated with baryta it is converted into *tropine* and *tropic* acid, both of which are also obtained from atropine.

The great discrepancy between A. Ladenburg's account and the Baron von Mueller's can, I think, be only accounted for by the supposition that Ladenburg must have been supplied with a different material. Baron von Mueller and Rummel (*Jour. Chem. Soc.*, January, 1879), state very plainly that the *Duboisia myoporoides* yields a *volatile oily* alkaloid, and this is again confirmed by the extract from the Baron's letter, already quoted.

In the same paper Baron von Mueller also describes pituric or duboisic acid obtained from the precipitate given by the piturie on the addition of basic acetate of lead.

In the *Pharmaceutical Society's Journal* for April 5, 1879, there is an account of an examination of some piturie made by M. Petit, of Paris, in which he comes to the conclusion that the alkaloid is identical with nicotine; but M. Petit does not seem to have had sufficient material to permit a combustion to be made of the alkaloid; he had to rely mainly upon its reactions with certain chemicals, and apparently was only able to make one determination each of the platinum and chlorine in the platinum salt; the amounts of which apparently roughly corresponded with those required for the chloro-platinate of nicotine, viz., 34·4 per cent platinum and 37 per cent chlorine, the percentages obtained being platinum 34·0 per cent and chlorine 36 per cent. These results, however, cannot be regarded as final, since, as will be shown later on, the platinum salt cannot be depended upon, as it is not of uniform composition.

Preparation of the Alkaloid.

The piturie was extracted with boiling water slightly acidified with sulphuric acid, the liquid concentrated by evaporation and distilled with an excess of caustic soda,

---

[*] *Frag. Phytograph*, x., 20, Baron von Mueller.

[†] Piturie and Tobacco, by Dr. Bancroft, *Jour. Queensland Phil. Soc.*, 1879.

[*] Metatungstate of soda.

the alkaline distillate neutralised by hydrochloric acid, evaporated over a water-bath until reduced to a small bulk; as the residue was of a yellowish colour it was once more distilled with caustic soda, the distillate neutralised with hydrochloric acid and again concentrated; it was now nearly colourless, caustic soda was again added, and the liquid shaken up with ether.

The ether was next removed by distillation at as low a temperature as possible in a current of hydrogen, the heat meanwhile being raised gradually until it reached 140° C., a bath of sulphuric acid being used for this purpose. It was allowed to remain at this temperature for about six hours; the bath was then removed, and the distillation continued at a still higher temperature over a naked flame, the current of hydrogen being still maintained, until all the alkaloid, with the exception of a very small quantity, which had become charred, had passed over in a clear and colourless condition. During the distillation the thermometer indicated a temperature between 243° and 244° C.

I. 60 grms. of the substance gave 0·622 grm. of the alkaloid, or 1·037 per cent. In this case the alkaloid was not allowed to boil, but was maintained at a temperature of 140° C. in a current of hydrogen for several hours, to remove water and traces of ammonia.

II. In a second experiment 500 grms. of the piturie gave 12·34 grms. of alkaloid, or 2·47 per cent, when distilled in a current of hydrogen.

The piturie did not contain any non-volatile alkaloid.

The alkaloid when freshly prepared is clear and colourless, but with access of air rapidly becomes yellow, and finally brown, especially when exposed to the sunlight. In a sealed tube one specimen has remained unchanged during the past eight months.

It is soluble in all proportions in water, alcohol, and ether, yielding colourless solutions. On paper it produces a greasy stain, which disappears after a time.

No determinations by weighing have yet been made of its specific gravity, but it is just a little heavier than water, a drop of it sinking slowly to the bottom of a vessel of distilled water.

When freshly prepared its smell is very like that of nicotine; afterwards, when darkened in colour and thickened in consistency, the odour is more like that of pyridine.

It is volatile at ordinary temperatures, its vapour forming a dense fog with hydrochloric acid. Its vapour irritates the mucous membranes very much, and when working with it induces violent headaches.

The taste is acrid and pungent, and very persistent.

It neutralises acids completely; but the neutral solutions of acetate, sulphate, and hydrochloride all become acid on evaporation from the loss of alkaloid.

Oxalic acid is the only acid which yields a crystalline salt, but this is more or less mixed with free acid, from the loss of alkaloid by volatilisation, an acid salt mixed with free oxalic acid being left.

The acetate, sulphate, and hydrochloride, when kept over strong sulphuric acid, dry up into hard, brittle, transparent, varnish-like substances, without the slightest trace of crystallisation, even after standing for months. All these compounds are very hygroscopic, especially the sulphate, and are very readily soluble in alcohol.

PROCEEDINGS OF SOCIETIES.

PHYSICAL SOCIETY.

Saturday, March 12, 1881.

Sir W. Thomson in the Chair.

New members—Mr. Colville Brown, Dr. J. P. Joule.

Col. Festing read a paper by Captain Abney and himself "*On the Absorption-Spectra of Organic Bodies.*" The method of photographing the infra-red region of the spectrum gave better results for absorption than the thermopile. Organic compounds were chosen as giving the larger molecules. The apparatus employed consisted of a small Gramme machine driven by a Brotherhood engine, and an electric lamp with a device for shifting the negative pole, so as to get the crater on one side of the other carbon point. The image of the positive pole was allowed to fall on the slit of the spectroscope, the light of the arc not being used. Three prisms were used and a camera with a back swing to it, so as to get a considerable length of spectrum in focus. Maps of the various spectra were made with six inches of the substance examined enclosed in a glass tube. Alcohols, acids, oils, and water were examined, and some spectra of bands and lines. When hydrogen was absent in the compound there were no lines, and the authors conclude the lines to be due to hydrogen. Oxygen appeared to obliterate the space between two lines and make it a band. The authors hope by this method to detect the radicles present in a substance. They found correspondences between some lines, and lines in the solar map.

Dr. Coffin said that two kinds of chloroform apparently the same produced different physiological results: the method might distinguish between these.

Sir William Thomson thought it might throw light on the ultimate constitution of matter.

Mr. Brown read a paper on the "*Definition of Work in Text-Books,*" and gave reasons for preferring that in Rankine's books.

NOTICES OF BOOKS.

Experimental Chemistry for Junior Students. By J. Emerson Reynolds, M.D., F.R.S., Professor of Chemistry, University of Dublin. Part I., Introductory. London: Longmans, Green, and Co.

Were this book one of the routine elementary treatises on chemistry which appear season after season in such unaccountable profusion, and which drive reviewers to despair, we should be compelled to dismiss it with a sentence or two purposely devoid of deep meaning. But even on a very superficial inspection it appears that Dr. J. E. Reynolds fills a distinct and readily defined position. He builds his course of instruction from the very outset upon experiments. The student is to learn not from the words of the book, but from certain facts, presented in a simple and natural order. The task which the author undertakes is to show how these facts are to be brought before the eyes of the learner. Nothing is advanced which is not thus distinctly placed in evidence. Thus the difference between physical and chemical action, the determination of the latter by mechanical force, by light, electricity, &c., are not laid down as something to be accepted, with or without a clear understanding, but are shown in action. Hence the knowledge of chemical science acquired by students who follow the course here laid down will be from the very first clear and thorough. It is therefore reasonable to suppose that they will continue in the same direction, and as their knowledge extends, and as some of them perhaps, not content with acquiring what has been discovered by others, press on to extend the boundaries of the science, they will still continue at every step to call for experimental evidence. Chemistry thus acquired may be even more valuable as a process of mental discipline than from the mere facts or the deductions inculcated. It will teach the student how to draw right conclusions from facts correctly observed; and how much of the business of life is summed up in these few words! The experiments here described are simple, and the apparatus needful is cheap and easily procurable. Hence we may with a good conscience recommend this little book alike to private students and to the heads of schools who are hesitating about the introduction of chemistry into their curriculum.

The Ventilation of Dwelling-Houses, and the Utilisation of Waste Heat from Open Fire-places, including Chapters on London Smoke and Fog, Modern Fireplaces, &c. By F. EDWARDS, jun. London: Longmans, Green, and Co.

THE fogs of the winter of 1879-80 seem to have made a deep and lasting impression, not merely upon the lungs, but upon the brains of a great part of the community. With the question of the origin and possible abatement of this nuisance, certain collateral subjects, such as the warming and ventilation of our houses, are very closely connected, and are being discussed not merely by scientific and semi-scientific personages, but by the general public. As a community we have to take heed lest in throwing off the ills we have so long borne with patience we do not incur such as are greater. Bearing in mind what an insignificant fraction of heat-giving power we obtain from the fuel burnt in our dwellings, it may surely be demanded that the reform adopted, whatever it be, should before all things involve a reduction and not an increase of cost.

The work before us criticises incisively, but not unjustly, many of the "improved" methods of warming which are now urged upon our attention. The writer recognises the value of gas for cooking, but, unlike Dr. A. Carpenter, he shows very good grounds for doubting its general utility or economy for warming rooms. The proposed tax on fireplaces not so constructed as to burn their own smoke he condemns. It would be, in fact, as oppressive an enactment as was ever forced upon a conquered country, since it would fall upon those who have not the means to make alterations in the houses which they inhabit.

Anthracite is difficult to kindle, and is out of court in those multitudes of cases where one and the same open fire has to serve both for warming and cooking. What, moreover, would be its price if all other coal were interdicted in London? The author refers also to the proposal of having the fuel partially freed from its volatile constituents at the gas-works, as expounded in a paper recently read before the Society of Arts. According to the propounder of this scheme the coal thus treated is to be sold at 23s. per ton, which is far too high for the interest of the community. As regards Mr. Spence's scheme of carrying all the fire-gases into the sewers and discharging them through a chimney 600 feet high and—in case of Manchester—100 feet in diameter, the author points out certain serious engineering difficulties, and calculates that the chimney would require a diameter of 720 feet! We do not join him in his opinion that the plan of heating houses entirely by hot water, steam, or hot air "is quite inapplicable in so variable and temperate a climate as ours." This system of heat, as is proved in conservatories, admits of being most nicely regulated according to the external temperature. But except in large buildings, or where a whole row of houses is to be heated simultaneously, it is utterly inadmissible on the score of cost.

The author's own schemes have in them nothing of a startling character. In kitchens he would have ovens and boilers heated from below by means of a closed stove fed with anthracite. We may here remark that the plan of heating ovens from above, as now common in London and the south of England, is an absurdity devised by some ironfounder, careless or ignorant of the laws of heat, and anxious chiefly to dispose of a maximum weight of cast-metal. For dwelling-rooms he proposes a special fire-grate fed from below by dint of a special contrivance which is here figured. In consequence there will be little smoke given off except when the fire is first kindled. There is another very important point by which much heat would be economised. In our present houses the column of heated air ascending from the fires in the lower stories is enclosed within such thick masses of masonry that it contributes nothing towards improving the temperature of the upper rooms. Mr. Edwards, therefore, proposes to convey the products of combustion upwards through iron, or possibly stoneware, pipes, so that they may warm and dry the bedrooms. He gives diagrams showing the necessary arrangements. Here, however, the individual is utterly powerless.

As a further improvement he suggests the use of double windows, such as are very common on the Continent, or, if these be too costly, double panes of glass, fixed at the distance of a quarter of an inch from each other, but in the same frame. However, so long as the sashes, doors, &c., are constructed in the present disgraceful manner, these arrangements would be of little service.

On the subject of ventilation the author seems too anxious. He apparently overlooks the fact that except the walls of a house are constructed of marble, or are coated within with varnished papers or oil-paint, a constant interchange of air takes place through the bricks or stones themselves. The ventilation effected by an open fireplace is unsatisfactory, as it affects chiefly the lower part of a room, leaving a reservoir of impure air next the ceiling, which is only very slowly and imperfectly removed. The lower the firegrate is fixed the more decidedly is this the case.

Mr. Edwards thinks it hopeless to induce the English public to take to close stoves. But when and where has a fair trial been made with a fireclay stove as used in Germany? We for our part should give it the preference. On a great number of points we decidedly agree with the author, and consider that he has hitherto scarcely met with fair treatment in attempting to bring his views before the public. In these days the question is not so much what is said as by whom it is uttered.

CORRESPONDENCE.

THE ATMOSPHERIC OXIDATION OF MOIST PHOSPHORUS.

To the Editor of the Chemical News.

SIR,—In his recent article (CHEMICAL NEWS, vol. xliii., p. 97), Dr. A. R. Leeds has said so much about me and my work, that for the purpose of avoiding permanent misrepresentation, I am bound to claim your indulgence to enable me to reply very briefly upon this subject.

In the first place, I am charged with a change of views. I do not object to this particularly, but it would have been more agreeable had Dr. Leeds allowed that I had rather extended than changed my views. From the outset of this discussion, I was convinced that peroxide of hydrogen would be found as a chief product of the atmospheric oxidation of phosphorus, and having been largely concerned with the production of this substance by other chemical processes of limited oxidation, it was to be expected that this part of the subject would have, for me, more interest than the possible simultaneous formation of ozone. Moreover, at that time, it was thought hardly possible for ozone and peroxide of hydrogen to be present in mixture, for, as Prof. H. McLeod said in his paper (*Jour. Chem. Soc.*, 1880, p. 120), "the bodies mutually decompose one another under certain conditions."

For all that, however, I am never ashamed of a change of opinion. To every scientific man change of opinion is inevitable, because it is coincident with the progress made in science. Dr. Leeds has experienced this fact also, for at one time he stated (CHEMICAL NEWS, vol., xxxviii., p. 236), ozone to be produced by the action of oxalic acid upon potassic permanganate, and at a subsequent time (vol. xxxix., p. 18) retracted this opinion.

I may at once state that I shall pass over much of what is put forward by Dr. Leeds, simply because it is undoubtedly hypercritical or even more unworthy of serious consideration, and shall confine my reply to certain salient points in the subject under discussion.

Dr. Leeds endeavours to explain away the fact that he entirely overlooked the presence of peroxide of hydrogen in the water containing the phosphorus, but the fact remains that, in his paper (Chemical News, vol. xl., p. 73), he merely determined that substance contained in the washing-water. How far this was accidental is nothing to me, but I may remind him that in a much later communication (vol. xli , p. 165), he repeats the omission, and as the result of his investigation says, without limit or reservation of any kind, that the percentage of peroxide of hydrogen, as related to the air aspirated, "was 0·00038," or "but 1-400th part of the ozone."

Next, Dr. Leeds unfairly represents my criticism of this result. He says, I charged him with looking for hydrogen peroxide in an acidified potassium bichromate solution. Not at all. Finding that he did not examine, for peroxide of hydrogen, the water (where used) in which the phosphorus was partially submerged, I said the use of bichromate in the other cases "precluded examination." I submit that my criticism will not bear Dr. Leeds's interpretation.

Dr. Leeds may rest assured of the fact that I used pure water, although I did not style it "*aqua purissima*," and that I avoided all real sources of error. Indeed, as will be evident to any chemist who compares our results, the investigations made by Dr. Leeds, and my own research, lead practically to the same conclusions. The chief matter on which we disagree I shall refer to hereafter and emphasise. In the meantime, I claim for my research that it once for all and for the first time proved that peroxide of hydrogen ranks in importance with ozone as a product of the atmospheric oxidation of phosphorus; it also explained the absorption of the whole molecule of ozone by turpentine, and it furnished some useful information regarding the reactions of peroxide of hydrogen and the methods employed for estimating that substance.

The peroxide of hydrogen I found to be entirely dissolved in the water containing the phosphorus. The washing-water through which the gas from five oxidisers was passed, gave the merest traces of this substance, and the other active product (ozone) was, on the one hand, entirely absorbed by turpentine and, on the other hand, destroyed by exposure to 240°. Apparently, nothing could be more conclusive; but Dr. Leeds will have it that peroxide of hydrogen passes from the oxidisers, escapes through the washing water, fails to be absorbed or decomposed by a solution of strong sulphuric acid and by passing through tubes 2·5 metres in length containing beads moistened with the same acid, but is at length decomposed by exposure to an elevated temperature, and he claims to have weighed the water thus formed. Now in the *Journal of the Chemical Society* (1880, p. 799), I have shown that even if we trust the figures of Dr. Leeds, the rise in the water produced does not follow the increase of temperature as laid down by that experimenter. But what is more, I distinctly challenge the accuracy of the figures, and I do not believe that any water was produced. Dr. Leeds says, 0·016 grm. is a ponderable quantity. So it is, but let us see how he arrives at this ponderable quantity. In twelve experiments his test apparatus increased in weight as follows (see Chemical News, vol. xlii., p. 19):—

0·0015; 0·0010; 0·0000; 0·0010; 0·0011; 0·0002; 0·0015; 0·0003; 0·0000; 0·0018; 0·0002; 0·0000.

These figures summed up give 0·0086 grm., and if we assume the increase in each case to have been due to water resulting from the previous decomposition of peroxide of hydrogen, then the total amount would be equivalent to 0·016 grm. H_2O_2. But for my part, I do not think this is a fair way of obtaining a ponderable quantity.

Dr. Leeds used 12 litres of ozonised air in each experiment; sometimes he got no increase at all in the weight of his test-apparatus, and where he did get an increase, the amount even in the most favourable instances was scarcely outside the recognised limits of error. In fact, in my opinion, Dr. Leeds has given us here not a ponderable quantity of water, but the sum of twelve errors of experiment. Moreover, in these twelve experiments, Dr. Leeds found a total quantity of 0·00029 grm. of hydrogen peroxide in all his washing water, but again he has neglected the water in the vessels in which the phosphorus was oxidised, which water I have shown to contain practically all, or quite all, the peroxide of hydrogen which is produced, and this is so large in amount as to offer no difficulties in its proper estimation.

I am perfectly well aquainted with the white cloud that forms in the oxidisers, and which is more or less persistent to the end of the apparatus. When the current of air was sufficiently slow there was really no cloud observed at the end of my apparatus. In the Chemical News (vol. xl., p. 74), Dr. Leeds speaking of the white fumes in the ozonators said, "they are chiefly due to phosphoric anhydride," so I suppose it must be only at the other end of the apparatus that the fumes become antozonic in nature. Again (vol. xli., p. 164), Dr. Leeds says, speaking of the white fumes observed over potassic iodide solution exposed to the ozonised air, "this white cloud is the antozone of Schönbein and other authors. It is, in fact, peroxide of hydrogen held in a state of aqueous solution, *and is the product of the action of the ozone upon the potassium iodide solution*." I should like to see the proof of this statement, but I am afraid that is a pleasure which will be denied to me.

One other point and I have said all I intend to say just now upon this subject. Dr. Leeds thinks that turpentine may absorb peroxide of hydrogen in this antozonic condition. Well, he is safe in taking refuge under a supposition that cannot be tested, so far, experimentally. But there is this to be said, that, under ordinary laboratory conditions, oil of turpentine does not absorb peroxide of hydrogen, but on the other hand,—and this is very significant as regards the argument—it gives rise to that substance by its aërial oxidation in presence of water. Indeed, to my mind Dr. Leeds's proposition is indefensible on every chemical ground.—I am, &c.,

C. T. Kingzett.

BENZOL TESTING.

To the Editor of the Chemical News.

Sir,—Having had some years' experience in testing benzols, &c., I find from that experience the points to be observed are:—1st. Uniform capacity and thinness of retorts; 2nd. Thin-bulbed thermometers with solid stems of proved accuracy; 3rd. Heating retort with hot air, and not by flame impinging on retort; this is accomplished by supporting retort on ring from which depends a cylinder of wire gauze, about 1¾ inches diameter and 6 inches long; the burner, with flame about an inch long, placed inside cylinder, and raised or lowered until boiling is regular. 4th. Barometric pressure of atmosphere at time of making test. 5th. Treating the process as a *technical* one, suitable to the requirements of *tar distillers* and aniline makers; not to be "improved" upon by every manipulator who fancies the process a "stupid" one, and in his opinion therefore inaccurate.

One *trial* of the apparatus your correspondent, Mr. Wm. Thomson, suggests, will be sufficient to demonstrate which, in the opinion of manufacturers, is the "stupid" process.

Finally, from my experience in these matters, I find that when the conditions imposed by the instructions, and allowed by *general* experience, are adhered to, the test as now used is remarkably accurate; and, further, commercial honesty, or *dishonesty* might I say, has a great deal to do with disputes arising from sale and purchase of benzols, &c.—I am, &c.,

William Bettel.

Analytical Laboratory and Assay Office,
The Grove, Worcester.

BENZOL TESTS.

To the Editor of the Chemical News.

Sir,—The letter of your correspondent, W. Thomson (Chemical News, vol. xliii., p. 115), calls for a few remarks. It was not my intention to take part in this controversy again. I had hoped that other tar chemists would have taken up this question, the importance of which may be seen when it is realised that some two to three million gallons of benzol are annually produced in the United Kingdom—representing a value of over £500,000.

After enumerating the instructions or details for testing, as usually printed on contract notes, Mr. Thomson proposes a new form of apparatus for the testing of benzols, which apparatus would require precisely the same attention to detail, size of flask, condenser, &c., would certainly be more trouble, would take from two to three hours each test, and would have the further disadvantage of not being so accurate or reliable as the present method—"stupid process," as Mr. Thomson calls it. If Mr. Thomson had had a few weeks' experience in the benzol refinery, he would not have been at the trouble of drawing the sketch of his apparatus, which, though it may not have been published before, is not new. Again, in testing benzols, there are other important points to be taken into consideration besides the percentages at 100° C. and 120° C., viz., the point of ebullition and the percentages at intermediate temperatures. Even supposing the apparatus would give accurate results at 100° C., it would be difficult to maintain steady temperatures at 120° C., 140° C., and 160° C.—points required in the testing of toluols, xylols, solvent naphthas. And for the purpose of testing crude naphthas containing benzol the apparatus would not be of the slightest use.

Wishing to give his apparatus a trial I, by means of a copper water-bath and retort, fitted up a similar apparatus, and placed in the retort 100 c.c. of 30 per cent benzol, a sample of which on testing on three successive days yielded exactly 31 per cent, the influence of the atmospheric pressure *not* being allowed for. After the water in the copper bath had been boiling about one and a half hours, 37 per cent distillate was recorded, whilst the thermometer in the retort had not registered more than 97° C.

The influence of an "aching void" within me being stronger than my faith in the process, I did not carry the experiment further, since the distillate had not ceased dropping. Just imagine a merchant, who had received half a dozen samples of benzol after dinner, the approval or acceptance of which he had to notify by return of post, having to test by this apparatus, or the works chemist who has the supervision of the benzol refinery. What anathemas would be poured forth! Mr. Thomson's remarks about the length of the bulbs of different thermometers are beside the question, since, as I mentioned in my previous letter, the thermometers used in various parts of the country for benzol testing vary but slightly, and in no instance would there be such a difference as 1 inch and $\frac{3}{8}$ths inch. A sample of benzol carefully tested by different tar chemists in similar apparatus would not vary by more than 1 per cent, atmospheric pressure being disregarded. But I could not say the same with regard to the testing of a sample of benzol by different analysts who have had *little* experience in coal-tar products. Many interesting instances could be given of the wonderful results obtained by analysts to whom samples of benzols, carbolic acid, creosote oils, &c., have been submitted.

I remember a case in the Manchester district, where a disputed sample of naphtha had been referred to an analyst who came over to the works from whence it had been sent to be shown how to test it, and went away charmed with the simplicity of the test. In a day or so his analysis was sent in, and found to be wrong to the extent of 20 or 30 per cent. He charged two guineas for the analysis, but explained afterwards that he would test future samples for 2s. 6d. each. It is needless to say he earned no half-crowns from that firm.

I would here refer to the letter of "J. D." (Chemical News, vol. xliii., p. 93), in which he states that he allows 0·8 per cent for every degree (by which I suppose he means every 1-10th of an inch) rise or fall in the barometric column, and he mentions an instance where he had to make a parcel of 30 per cent benzol up to 42 per cent, because the barometer indicated at the time 28·5 inches. Since the buyers do not allow for barometric pressure, and a difference of 12 per cent means £30 or £40 per 1000 gallons, it would be a wise and profitable course for "J. D." to arrange with the Meteorological Office for reports of atmospheric changes. By judicious management he might arrange to deliver his benzol when the barometer was pretty steady; or, if he is inclined to be "cute," he might arrange for his benzol to reach buyer when the barometer indicated, say, 28·5, and thus pass 18 per cent benzol for 30 per cent: that is, supposing his statement to be correct, which is not so. Under ordinary circumstances the barometric pressure may be disregarded, under a great fall in the barometer; the result of the test might be affected 2 or 3 per cent, but not more. By the bye, does "J. D." correct his barometrical readings for temperature, and reduce to 0° C., and sea level? This, in many places, makes a difference of several degrees.

In conclusion, disputed tests of benzol are not so numerous as the correspondence would lead one to suppose—no more numerous than disputed tests in the alkali trade—and the "stupid process" in experienced hands is quite as reliable, if not more so, than many of the elaborate processes for the analysis of water, butter, milk, &c. —I am, &c.,

William W. Staveley.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, l'Académie des Sciences. No. 7, February 14, 1881.

Periodic Movements of the Ground.—P. Plantamour.—The author gives an account of his observations on the movements of the ground from October 1, 1879, to September 30, 1880. The most remarkable feature is the sinking manifested on the eastern side from the end of November, 1879, to the end of January, 1880, which is much greater than might be expected from the absolute cold of the month of December, only −15°. A rise of temperature is always accompanied with an elevation of the ground level, and a fall of the thermometer is marked by a subsidence.

The Laws which Govern the Periods and the Coefficients of Intensity in one of the Principal Groups of Elementary Electromotor Forces due to Solar Induction, and the Possibility of Using a Magnetic Needle to Measure the Speed with which the Sun Revolves on its Axis.—M. Quet.—A mathematical paper, not capable of useful abridgment.

On M'Boundon, the Ordeal Poison of the Natives of the Gaboon: New Physiological, Chemical, Histo-Chemical, and Toxicological Researches.—E. Heckel and F. Schlagdenhauffen.—The poison employed contains exclusively one base, strychnine. The authors propose to examine whether the distinction between the tetanising and the paralysing species of the strychnos family may not depend simply on the proportion of the base which they contain.

Specific Magnetism of Ozone.—H. Becquerel.—Ozone being more magnetic than oxygen it is easy to see that the relation of the specific magnetism of ozone to that of oxygen is notably greater than the supposed relation of their densities. The specific magnetism of ozone is then greater than what would correspond to the quantity of oxygen which it contains.

Electric Phenomena of Tourmaline and of Hemihedral Crystals with Inclined Surfaces.—J. and P. Curie.—The hypothesis which the authors put forward is that there exists a constant difference of tension between the opposite surfaces of two successive layers. Tourmaline being a compound body the different parts of a crystalline molecule may be formed of different substances, which would explain the difference of tension of the opposite extremities of two molecules.

The Compounds of Hydrochloric Acid with Mercuric Chloride.—A. Ditte.—There exists a whole series of compounds of these two substances, several of which the author has isolated and analysed.

Violet Illumination of the Retina under the Influence of Luminous Oscillations.—A. Charpentier.—The author, fixing his eyes immoveably on a sky illuminated by a uniform white light, and moving two fingers of his right hand rapidly and alternately backwards and forwards before them, saw, after a minute, a remarkable change in the uniform aspect of the heavens. There appeared on a white ground a mosaic composed of rather deep violet-purple hexagons, separated from each other by white lines, and forming a very regular design. The oscillations of the fingers should be from 300 to 400 per minute. The author thinks that these hexagons are due to the cones in the fovea and in the yellow spot, and that the white lines are due to their intervals.

Determinations of the Fundamental Coloured Sensations by the Study of the Complementary Colours in the Chromatic Circle (Second Memoir).—A. Rosenstiehl.—The author taking as a basis the equidistance of the colours which form each of the three sections of the chromatic circle, succeeds in proving that there exist three colours, which possess special properties with reference to our sight.

A Glycoside extracted from Common Ivy.—L. Vernet.—The glycoside in question, $C_{64}H_{54}O_{22}$, is resolvable into a non-fermentible sugar, which reduces Fehling's liquid and a neutral body, tasteless, inodorous, dextro-rotatory, and agreeing with the formula $C_{52}H_{44}O_{12}$.

No. 8, February 21, 1881.

The Refrigerating Power of Gases and Vapours.—M. Witz.—This paper does not admit of useful abstraction.

Radiophony.—E. Mercadier.—Radiophonic effects are thermic, not luminous, and are produced by gases alternately heated and cooled, and not by solids or liquids.

Magic Mirrors of Silvered Glass.—L. Laurent.—The author has produced with glass effects similar to those of the Japanese metallic mirrors and those constructed by MM. Bertin and Duboscq.

Pyridic Bases.—Oechsner de Coninck.—A further account of the three bases which the author discovered in the products of the distillation of cinchonine with potassa.

Permanence of Hydrocyanic Acid for a Month in the Bodies of Animals Poisoned with the Pure Acid.—C. Brame.—Hydrocyanic acid, if administered in a sufficient quantity to animals, preserves them perfectly for a month. It remains in the tissues, and especially in those of the stomach for the same time. It appears to combine intimately with the animal tissues. In the Carnivora it is more difficult to extract by distillation than in the Herbivora.

Moniteur Scientifique, Quesneville.

October, 1880.

Certain Ultramarines.—C. Heumann.—A translation from *Liebig's Annalen.*

Société d'Encouragement.—An account of the prizes awarded to M. Camille Vincent and M. Abel Martin for their respective inventions.

New Treatment of Copper Pyrites: Substitution of Sulphur for Coal as Fuel.—X. Rocques.—A notice of the Hollway process and of certain proposed improvements.

Chemical Constitution of Albumen.—Dr A. Danilewsky.—The transformation of albumen into peptones is produced by a hydratation, which in each phase take place at a fixed part of the molecule. The regressive formation of albumen from its peptones is produced by a similar dehydration. When the molecule loses calcium and phosphoric acid the carboxylic groups appear, and give an acid reaction to the groups thus obtained. In certain phases the molecule may lose a portion of sulphur without being destroyed or changing its properties.

New Researches on the Albumens of Milk.—Dr. Danilewsky and P. Radenhausen.—The albumen of milk is a mixture of stroma-albumen, with small quantities of orro-proteine and the synto-protalbes. The lacto-proteine of Millon and Commaille is a mixture of soluble synto-protalbes, of syntogenes, and of peptones, which alone are precipitated by mercuric chloride. The same mixture with small quantities of peptones represents the galactine of Morin.

Assay of Oils.—A hydrometric process.

The Fourth State of Matter: A Refutation.—Dr. J. Puluj.—From the *Chemiker Zeitung.*

Development of the Cadaveric Alkalies (Ptomaïnes).—MM. Brouardel and Boutmy.—The authors have verified the presence of these poisons in the viscera of persons who had died either from the action of poisons or otherwise. The organs of an individual asphyxiated by carbonic oxide were analysed some hours after death, and found free from poison. On being re-examined eight days afterwards they contained a solid organic base, presenting the general characters of the alkaloids and proving fatal in small doses to frogs and guinea-pigs. The ptomaines are produced in the dead bodies of men and animals, and vary in their nature under circumstances not yet ascertained. They are poisonous in the majority of cases.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale.

No. 81, September, 1880.

Report presented by M. Troost on behalf of the Committee of the Chemical Arts on the Malleable Nickel of MM. Gaspard and Belle.—The metal is first brought to a state of complete fusion, its surface is freed from all traces of scoriæ, a small quantity of metallic zinc or magnesium is introduced, the whole is stirred up and run. The metal thus added seems to lay hold of all traces of foreign matter derived from the sides of the crucible. Such nickel is ductile and malleable at all temperatures below its point of fusion, and can be welded either with itself or with iron or steel. Plates and wires of iron or steel can thus be coated with nickel.

Report presented by M. de Luynes on behalf of the Committe of Economic Arts on M. Pinchon's Thermic Areometer for the Assay of Oils.—The instrument is a hydrometer containing a thermometer, a construction already known, but the special graduation adopted by M. Pinchon renders it useful in certain cases for detecting the relative purity of oils. For each oil there is a special spindle graduated so that for one and the same oil the indication of the hydrometer is the same as that of the thermometer. When the oil is pure the agreement between the hydrometric and thermometric degrees is maintained in spite of the variations of temperature. If the oil is mixed with other oils of a different nature this agreement ceases, and the deviation is the greater according to the proportion of the foreign oil added. A hydrometer graduated for olive oil if mixed, *e.g.*, with oils of colza, or of earth-nuts, deviations of from 3° to 13°. Between the temperatures of 15° and 18°, olive oil marking 15° to 18°, colza marks 20·5°, and oils of sesame and earth-nut 13°. At the temperature of 17·5° a mixture of 1 part colza and 3 parts olive oil marks 19°, whilst 1 par of oil of earth-nuts with 3 parts olive oil at 18° marks 17°

Justus Liebig's Annalen der Chemie,
Heft 1, 1880.

Communications from the Laboratory of the University of Würzburg.—These consist of a paper by Max Guthzeit on octyl-substituted acetic esters and their compounds, and a dissertation by E. Böcking on two new syntheses of ethyl-methyl-oxyacetic acid.

Mono-brom-aceton and the Alcohol of Aceton.—A. Emmerling and R. Wagner.—In this paper the authors describe the preparation of pure mono-brom-aceton, its behaviour with silver oxide and water, and with an aqueous solution of potassium carbonate. They also give an account of the properties of acetol. It is very soluble in water, boils about 100°, and volatilises with watery vapours. Its specific gravity is greater than that of water. Its solutions reduce alkaline copper oxide in the cold, red cuprous oxide being deposited. On oxidation with potassium dichromate and dilute sulphuric acid, it is resolved into 1 mol. acetic acid and 1 mol. carbonic acid.

Action of Ethyl- and Diethyl-amin upon Aceton.—Dr. O. Eppinger.—The author examines, first, the behaviour of ethylamin with aceton, describing ethyl-diacetonamin platinic chloride hydrochlorate, the corresponding platinous salt, ethyl-diacetonamin hydrochlorate, and ethyl-diacetonamin gold chloride hydrochlorate. He finds that ethyl-diacetonamin is decomposed even at common temperatures in the moment of liberation from its salts. Then follow descriptions of ethyl-diacetonamin nitrate, sulphate, oxalate,—neutral and acid—and picrate. Dr. Eppinger then examines the behaviour of diethylamin with aceton.

Investigations on the Alkaloids of Jaborandi Leaves.—Dr. E. Harnack and Dr. H. Meyer.—The authors hold that in these leaves there is present, along with pilocarpine, another base, jaborine.

Behaviour of the Cinchona Bases with Potassium Permanganate.—S. Hoogewerff and W. A. von Dorp.—By the oxidation of the bases, quinine, cinchonine, quinidine, and cinchonidine, under the conditions observed by the authors, they obtained ammonia, carbonic acid, oxalic acid, and a tri-carbopyridic acid.

A Voltaic Element of Aluminium.—F. Woekler.—There is placed in a glass, containing very dilute hydrochloric acid or dilute soda-lye, aluminium foil bent into a roll. Within it is placed an earthen cell containing concentrated nitric acid, into which plunges a smaller roll of aluminium foil. To each foil is soldered a piece of sheet aluminium, which projects through the cover of so-called hard caoutchouc.

Heft 2, 1880.

Communications from the Chemical Institute of the Royal Forest School at Aschaffenburg.—These contributions consist of a paper on the preparation of malonic acid ester, by M. Conrad; a general view of the preparation of the mono- and dialkyl-substituted malonic acids, by the same author; an account of ethyl-malonic acid, by the same author; a memoir on diethyl-malonic acid and diethyl-acetic acid, by the same; a paper on iso-propyl- and ethyl-methyl-malonic acids; iso-propyl- and ethyl-methyl-acetic acids, by M. Conrad and C. A. Bischoff; an account of dioctyl-malonic and dioctyl-acetic acids, by the same authors; an account of allyl- and di-allyl-malonic, allyl- and diallyl-acetic acids, by the same authors; a notice of benzyl-malonic ester and hydrocinnamic acid, hy M. Conrad; and, lastly, a memoir on benzyl-methyl-malonic acid, benzyl-methyl-acetic ester, benzyl-methyl-acetic acid, and the constitution of hitherto known acids, of the composition $C_6H_5.C_n H_{2n-2}COOH$.

MEETINGS FOR THE WEEK.

Monday, 21st.—London Institution, 5.
—— Medical, 8.30.
—— Society of Arts, 8. "The Scientific Principles Involved in Electric Lighting," Professor W. G. Adams, F.R.S.
Tuesday, 22nd.—Royal Institution, 3 p.m. "The Blood," Prof. Schäfer.
—— Civil Engineers, 8.
—— Medical and Chirurgical, 8.30.
Wednesday, 23rd.—Society of Arts, 8. "The Increasing Number of Deaths from Explosions, with an Examination of the Causes," Cornelius Walford.
—— Geological, 8.
Thursday, 24th.—London Institution, 7.
—— Royal, 4.30.
—— Royal Society Club, 6.30.
—— Society of Arts, 8. "The Future Development of Electrical Appliances," Prof. John Perry.
—— Royal Institution, 3. "Ornament," Mr. H. H. Statham.
Friday, 25th.—Royal Institution, 8. "Weather and Health of London," Mr. A. Buchan, 9.
—— Quekett, 8.
—— Society of Arts, 8. "The Tenure and Cultivation of Land in India," Sir George Campbell, K.C.S.I., M.P.
Saturday, 25th.—Royal Institution, 3. "American Humourists," Rev. H. R. Haweis.
—— Physical, 3.

TO CORRESPONDENTS.

A. J. S.—The reactions you speak of are worth following up as they may lead to something new.

SOLAR PHYSICS.

The following Courses of Lectures will be given by Members of the Committee on Solar Physics, appointed by the Lords of the Committee of Council on Education:—

An Introductory Lecture. By Professor Stokes, Sec. R.S. 6th April, 1881.

A Lecture on the Practical Importance of Studying the Influence of the Sun on Terrestrial Phenomena. By Lieut.-General Strachey, R.E., C.S.I., F.R.S. 8th April.

Two Lectures on the Connection between Solar and Terrestrial Phenomena. By Professor Balfour Stewart, F.R.S. 27th and 29th April.

Six Lectures on Spectroscopy in Relation to Solar Chemistry. By Mr. J. Norman Lockyer, F.R.S. 4th, 6th, 11th, 13th, 18th, and 20th May.

Three Lectures on the Photography of the Infra-red of the Spectrum in its Application to Solar Physics. By Captain Abney, R.E., F.R.S. 25th and 27th May and 1st June.

The Lectures will be delivered in the Lecture Theatre of the South Kensington Museum, at 4 p.m., on the days stated above.

Admission will be by Tickets, which may be obtained, as far as there is room, on application by letter to the Secretary, Science and Art Department, South Kensington, S.W.

INSTITUTE OF CHEMISTRY OF GREAT BRITAIN AND IRELAND.

Incorporated under the 30th and 31st Victoria, Chap. 131, Sec. 23, on October 2nd, 1877.

LIST OF OFFICERS AND COUNCIL FOR 1881.

President—F. A. ABEL, C.B., F.R.S., &c.

Vice-Presidents.

James Bell, F.C.S.
E. Frankland, Ph.D., D.C.L., F.R.S., &c.
W. N. Hartley, F.R.S.E., F.C.S.
E. J. Mills, D.Sc., F.R.S.,
T. Redwood, Ph.D., F.C.S.
H. E. Roscoe, Ph.D., F.R.S.,

Treasurer—C. R. Alder Wright, D.Sc., F.C.S.

Ordinary Members of Council.

John Attfield, Ph.D., F.R.S., &c.
Dugald Campbell, F.C.S.
A. Dupré, Ph.D., F.R.S., &c.
R. J. Friswell, F.C.S.
P. Griess, Ph.D., F.R.S., &c.
C. W. Heaton, F.C.S.
Douglas Herman, F.C.S.
J. F. Hodges, M.D., F.C.S.
David Howard, F.C.S.
E. W. T. Jones, F.C.S.
T. W. Keates.
C. T. Kingzett, F.C.S.
J. W. Kynaston, F.C.S.
F. A. Manning, F.C.S.
W. Odling, M.A., M.B., F.R.S., &c.
F. J. M. Page, F.C.S.
John Pattinson, F.C.S.
B. H. Paul, Ph.D., F.C.S.
J. Spiller, F.C.S.
T. Stevenson, M.D., F.C.S.
A. Norman Tate.
C. Meymott Tidy, M.B., F.C.S.
W. A. Tilden, D.Sc., F.R.S., &c.
R. V. Tuson, F.C.S.
A. Voelcker, Ph.D., F.R.S., &c.
W. Wallace, Ph.D., F.R.S.E.
T. Way, F.C.S.

Secretary—C. E. Groves, F.C.S.
Offices—Somerset-house-terrace, W.C.

This Institute has been established to ensure that consulting and analytical chemists are duly qualified for the proper discharge of the duties they undertake, by a thorough study of chemistry and allied branches of science, in their application to the arts, public health, agriculture, and technical industry.

The Members of the Institute are divided into two grades, having the distinguishing ranks or degrees of Fellow and Associate respectively.

In the case of a Fellow, the Council requires that the candidate should have been admitted to the Institute as an Associate; and that since his admission, and for a period of three years therefrom, he should have been continuously engaged in the study and practical work of Applied Chemistry in a manner satisfactory to the Council.

In the case of Associates, the present regulations require every applicant for admission to this grade to submit to a stringent examination in practical chemistry, and to show to the satisfaction of the Council that he has passed through a course of three years' study of theoretical and analytical chemistry, physics, and elementary mathematics. An Associate must be at least 21 years of age before admission, and is not eligible for the higher rank of Fellow until he has been continuously engaged for three years in the study and practical work of Applied Chemistry, in a manner that shall be considered satisfactory by the Council.

FELLOWS.

Abel, F. A., C.B., F.R.S., F.C.S., Royal Arsenal, Woolwich, S.E.
Abney, Capt. W. W., F.R.S., 3. St. Alban's-road, Kensington, W.
Ackroyd, William, M.Ph S., Wharf-street, Sowerby-bridge, Yorks
Acworth, J. J., F.C.S., Vitriol Works, near Abbey Mills, Stratford, E.
Adair, Alfred, 2, Route du Landi, St. Denis, Paris
Aitken, A. P., D.Sc., F.R.S.E., Royal Veterinary College, Edinburgh
Allen, Alfred H., F.C.S., 2, Collegiate-crescent, Sheffield
Alison, R. E., 37, Lamb's Conduit-street, W.C.
Allison, Henry T., Thornaby Iron Works, Stockton-on-Tees
Angell, Arthur, Ph.D., 4, Portland-terrace, Southampton
Angell, John, F.C.S., Grammar School, Manchester
Appleyard, G. C. W., 2, Gardeners' Buildings, North Road, Clayton, Manchester
Armstrong, H. E., Ph.D., F.R.S., London Institution, E.C.
Ashwell, J. R., New Basford, Nottingham
Atkinson, Edmund, Ph.D., F.C.S., Portesbury-hill, Camberley
Atkinson, Robert William, B.Sc., F.C.S., University of Tokiô, Japan
Attfield, John, Ph.D., F.R.S., F.C.S., 17, Bloomsbury-square, W.C.
Bamber, H. K., 5, Westminster Chambers, Victoria Street, S.W.
Bannister, Richard, F.C.S., Laboratory, Somerset-house, W.C.
Barff, Frederick S., F.C.S., 100, Abbey-road, Kilburn, N.W.
Barrett, Edward Louis, B.Sc., F.C.S., 53, Springfield-road, N.W.
Bassett, Henry, F.C.S., 26, Belitha-villas, Barnsbury, N.
Baynes, James, jun., F.C.S., Kingston-upon Hull
Bean, Charles Edward, F.C.S., Brooklyn-house, Shepherd's-bush, W.
Beilby, George, Midcalder, Scotland
Bell, J. Carter, F.C.S., Assoc. R.S.M., Kersal Clough, Higher Broughton, Manchester
Bell, James, F.C.S., Laboratory, Somerset-house, W.C.
Bell, William Gomm, Assoc. R.S.M., 52, Duchess-road, Birmingham
Bernays, A. J., Ph.D., F.C.S., St. Thomas's Hospital, S.E.
Best, T. F., 66, Aldersgate-street, E.C.
Bickerdike, William Edward, F.C.S., Surbiton-place, Blackburn
Bickerton, A.W., Christchurch, New Zealand
Bischof, Gustav, F.C.S., 4, Hart-street, Bloomsbury, W.C.
Bourchier, Charles Edward, Messrs. Birdley and Co., The Brewery, Burton-on-Trent
Bowdler, Arthur Clegg, 20, Wellington-street, Blackburn
Bowrey, James John, F.C.S., Kingston, Jamaica
Brady, H. B., F.R.S., Hillfield, Gateshead
Brazier, James Smith, F.C.S., University, Aberdeen
Brock, John, British Alkali Works, Widnes, Lancashire
Brown, A. Crum, M.D., D.Sc., F.C.S., 8, Belgrave-crescent, Edinburgh
Brown, Adrian John, F.C.S., Burton-on-Trent
Brown, Edwin Ormond, F.C.S., Royal Arsenal, Woolwich, S.E.
Brown, James Campbell, D.Sc., F.C.S., Liverpool
Brown, Horace T., F.C.S., Burton-on-Trent
Buch, Carl Von, B.A., Laboratory, Christchurch, Oxford
Buchanan, John Young, F.R.S.E., 10, Moray-place, Edinburgh
Bullock, J. Lloyd, F.C.S., 3, Hanover-street, W.
Burge, Charles H., Laboratory. Somerset-house, W.C.
Burghardt, Charles Anthony, Ph.D., Owen's College, Manchester
Butterfield, John Cope, F.C.S., 106, Queen Victoria-street, E.C.
Calderwood, John, Addiewell, West Calder, Scotland
Cameron, Charles A., M.D., F.R.S.C.I., 15, Pembroke-road, Dublin.
Cameron, James, Laboratory, Somerset-house, W.C.
Cameron, John Macdonald, F.C.S., 7, Oxford-Villas, Glenthorne-road, Hammersmith
Cammack, John, Shaw Street, St. Helen's, Lancashire
Campbell, Dugald, F.C.S., 7, Quality-court, Chancery-lane, E.C.
Carey, Eustace, Widnes, Lancashire
Carpenter, R. F., 56, Regent's Park Road, N.W.
Carteighe, Michael, F.C.S., 180, New Bond-street, W.
Caswell, Charles Benjamin, F.C.S., 13, George-road, Birmingham
Church, A. H., F.C.S., Royston House, Kew
Clark, John, Ph.D., F.C.S., 138, Bath-street, Glasgow
Claudet, F., F.C.S., 6 and 7, Coleman-street, E.C.
Cleaver, Edward Lawrence, F.C.S., 289a, King's-road, S.W.
Cleminshaw, Edward, F.C.S., Greenhill, Sherborne
Cloud, T. C., F.C.S., Assoc. R.S.M., Wallaroo, South Australia
Clowes, Frank, D.Sc., F.C.S., Newcastle-under-Lyme
Coleman, Joseph James, F.C.S., 45, West Nile-Street, Glasgow
Collinge, T. A., 1, Milton-street, Rochdale
Cooke, Samuel, M.A., College of Science, Poona, India
Coomber, Thomas, F.C.S., 80, Kingsdown-parade, Bristol
Corfield, W. H., M.A., M.D. (Oxon), F.C.S., 10, Bolton-row, Mayfair, W.
Cownley, Alfred John, F.C.S., 13, Fenchurch-avenue, E.C.
Cranston, George, Messrs. Storer and Sons, Sydney-street, Glasgow
Criper, W. R., Assoc. R.S.M., Carew and Co., Rosa, N.W.S., India
Crookes, William, F.R.S., F.C.S., 7, Kensington Park Gardens, W.
Crowder, William, 2a, Evering Villa, Evering-road, Upper Clapton, E.
Dalziel, John Graham, F.R.S.E., United College, St. Andrew's, N.B.
Darby, Stephen, F.C.S., 140, Leadenhall-street
Darling, William Howarth, F.C.S., 126, Oxford-street, Manchester
Davies, Edward, F.C.S., Royal Institution, Liverpool
Davies, R. Higgins, F.C.S., Rutland-road, Hammersmith, W.
Davis, G. E., F.C.S., Dagmar-villa, Heaton Chapel, near Stockport
Davis, Henry Wilson, Laboratory, Somerset-house, W.C.
Day, James John, 18, London-street, Derby
Deacon, Henry Wade, Appleton-house, Widnes
De Chaumont, Francis, S.B.F., M.D., Army Medical School, Netley
Deering, W. H., F.C.S., Royal Arsenal, Woolwich, S.E.
De la Rue, Warren, D.C.L., F.R.S., F.C.S., 73, Portland-place, W.
Dent, William Y., F.C.S., Royal Arsenal, Woolwich, S.E.
Dewar, James, F.R.S., Cambridge
Dibdin, W. J., 37, St. Stephen's Avenue, Shepherd's Bush, W.
Dickinson, A. J., Neptune Tar Works, Trundley Lane, Deptford, S.E.
Dittmar, W., Anderson's College, Glasgow
Divers, E., M.D., F.C.S., Imperial Coll. of Engineering, Tokio, Japan
Dixon, William A., F.C.S., Laboratory, School of Arts, Sydney
Dodd, Thomas Henry, F.C.S., Las Minas de Rio Tinto, Rio Tinto, Huelva, Spain
Donkin, W. F., M.A., F.C.S., St. George's Hospital, S.W.
Dougall, Samuel S., Glenpark-villa, Busby, near Glasgow
Downar, George Frederick, 1, Chapel-road, Bexley-heath, Kent
Dreyfus, Charles, Clayton Aniline Co., Limited, Clayton, Manchester
Duncan, James, F.C.S., 71, Cromwell-road, S.W.
Dupré, Auguste, Ph.D., F.R.S., Westminster Hospital, S.W.
Dyer, Bernard, F.C.S., 17, Great Tower-street, E.C.
Early, William, Trinity College, Dublin
Estcourt, Charles, F.C.S., St. James's-square, Manchester
Evershed, Frank, 138, Glenarm-road, Clapton, E.
Fairley, Thomas, F.R.S.E., F.C.S., 16, East-parade, Leeds
Farries, Thomas, F.C.S., 16, Coleman-street, E.C.
Fenton, Henry J. H., Christ's College, Cambridge
Ferguson, John, M.A., F.C.S., University, Glasgow
Ferguson, W. B., M.A., 2, Pensarn-terrace, Moss-lane East, Manchester
Field, Frederick, F.R.S., F.C.S., Upper Marsh, Lambeth, S.E.
Foord, George, F.C.S., Royal Mint, Melbourne
Foster, William, B.A., F.C.S., Middlesex Hospital, W.
Francis, Ernest E. H., F.C.S., George Town, Demerara
Frankland, E., D.C.L., F.R.S., F.C.S., Royal College of Chemistry, South Kensington Museum, S.W.
Friswell, R. J., F.C.S., 10, Clapton-square, E.
Fuller, W. J., F.C.S., The Retreat, Sutton, Surrey
Gale, Samuel, F.C.S., 338, Oxford Street, W.
Galloway, Robert, F.C.S., M.R.I.A., 47, Leeson-park, Dublin
Gardner, John, F.C.S., 11, St. Paul's-crescent, Camden-square, N.W.
Garrick, Andrew R., Ph.D., St. Helens, Lancashire
Gatehouse, James Wright, 36, Broad-street, Bath
Gilbert, John Henry, Ph.D., F.R.S., F.C.S., Harpenden, St. Alban's
Gilchrist, P. C., F.C.S., Assoc. R.S.M., 12, Well-road, Hampstead, N.W.
Gladstone, J. H., Ph.D., F.R.S., F.C.S., 17, Pembridge-square, Hyde-park, W.
Glover, G. T., F.C.S., 30, Donegall-place, Belfast
Gordon, Joseph Gordon, F.C.S., 20, King-street, S.W.
Graham, A. McDonald, F.C.S., 38, Albany-street, North Leith, Edinburgh
Graham, Charles, D.Sc., F.C.S., University College, W.

Greenaway, A. J., F.C.S., 11, Pemberton-gardens, Upper Holloway, N.
Greenway, Thomas, The Sheffield Smelting Company, Sheffield
Gregory, Henry Richard, 7, Quality-court, Chancery-lane, E.C.
Greville, Henry Leicester, F.C.S., 4, Moreland-villas, Lambton-road, Hornsey-rise
Griess, Peter, Ph.D., F.R.S., F.C.S., Burton-on-Trent
Grimwood, R., Laboratory, Court House, Marylebone.
Grosjean, B. J., F.C.S., J. B. Lawes' Chemical Works, Millwall, E.
Groves, Charles Edward, F.C.S., Somerset-house-terrace, W.C.
Gurney, H. S. Lewis, Wilderspool, Warrington.
Hake, C. N., Albyn House, Parson's Green, Fulham, S.W.
Hake, H. W., Ph.D., F.C.S., Queenwood College, near Stockbridge, Hants
Halse, William Edward, F.C.S., 21, Mincing-lane, E.C.
Hanbury, Cornelius, F.C.S., Plough-court, E.C.
Hannay, J. B., F.C.S., Sword-street, Glasgow
Harcourt, Vernon A., M.A., F.R.S., Cowley Grange, Oxford
Harland, R. H., 123, Malmesbury-road, Bow, E.
Harkness, William, F.C.S., Laboratory, Somerset-house, W.C.
Harris, F. W., L. N. W. Railway, Crewe
Hartley, W. Noel, F.R.S.E., F.C.S., College of Science, Stephen's-green, Dublin
Hastings, H. Mitchell, F.C.S., 54, Edith-road, The Cedars, West Kensington, W.
Heaton, Charles William, F.C.S., Charing-cross Hospital, W.C.
Hehner, Otto, F.C.S., 54, Holborn Viaduct, E.C.
Heisch, Charles, City Gas Examiners' Office, 79, Mark Lane, E.C.
Helm, Henry James, F.C.S., Laboratory, Somerset-house, W.C.
Henry, William Charles, M.D., F.R.S., F.C.S., Haffield, near Ledbury
Herman, Douglas, F.C.S., Cropper's-hill, St. Helen's, Lancashire
Heron, Francis, Laboratory, Royal College of Surgeons, Dublin
Hewitt, David B., Beech-house, Prestwich, Radcliffe, near Manchester
Hibbert, Walter, F.C.S., 2a, Chapel-street, Edgware-road, W.
Higgin, James, F.C.S., Woodhey, Kersal, Manchester
Hill, Alfred, M.D., F.C.S., Birmingham
Hill, A. Bostock, M.D., Unity-buildings, Temple-street, Birmingham
Hills, Thomas Hyde, F.C.S., 338, Oxford-street, W.
Hodges, Frederick, Queen's College, Belfast
Hodges, John Frederick, M.D., F.C.S., Queen's College, Belfast
Hodgkinson, W. R., Ph.D., Newark House, Warbeck Road, Shepherd's Bush, W.
Hoffman, G. C., 76, St. Gabriel-street, Montreal, Canada
Holmes, John, Laboratory, Somerset-house, W.C.
Hopwood, G. Manley, F.C.S., Department of Agriculture, Melbourne
Howard, David, F.C.S., Rectory Manor, Walthamstow, E.
Howard, Thomas, F.C.S., 52, Swinton-street, Gray's-inn-road, W.C.
Howard, William Dilworth, Stratford, E.
Hughes, John, F.C.S., 79, Mark-lane, E.C.
Humpidge, T. S., Ph.D., B.Sc. (Lond.), University College, Aberystwyth
Huntington, Alfred Kirby, Assoc. R.S.M., King's College, W.C.
Hurter, Ferdinand, Ph.D., Widnes
Huskisson, Henry Owen, F.C.S., 42, Highbury-park, N.
Huson, C. W., B.Sc. (Lond.), 5, York-buildings, Dale-street, Liverpool
Hutchings, W. M., Mount Pleasant-road, Liscard, Birkenhead
Huxley, J. H., Assoc. R.S.M., Crescent-road, Sharrow, Sheffield
Ivey, W. E., Canterbury College, Christchurch, New Zealand
Jackson, Edgar, Assoc. R.S.M., 106, Queen Victoria-street, E.C.
Jameson, T., 235, Union-street, Aberdeen
Japp, Francis Robert, M.A., Ph.D., F.C.S., 27, Woodstock-road, Bedford-park, Turnham-green
Jarmain, George, F.C.S., 84, Northgate, Huddersfield
Johnson, George Stillingfleet, F.C.S., 11, Savile-row, W.
Johnson, Thomas H., F.C.S., 96, Duke-street, Liverpool
Johnstone, W., Athenæum-chambers, King's Lynn
Jones, E. W. T., F.C.S., Wolverhampton
Jones, Francis, F.R.S.E., F.C.S., Grammar School, Manchester
Jones, H. Chapman, F.C.S., 166, Blackstock-road, Highbury, N.
Jutsum, Sydney C., 14, Tredegar-street, Bow, E.
Keates, Thomas William, 10, Spring-gardens, W.
Keene, James Boddely, 38, Hartham-road, Camden-road, N.
Knights, J. West, County and Borough Analyst, Cambridge
Kellner, William, Ph.D., F.C.S., Royal Arsenal, Woolwich, S.E.
Kendall, James Alfred, F.C.S., Silvertown, E.
Kinch, Edward, F.C.S., Tokio, Japan
King, John Falconer, F.C.S., Edinburgh
Kingzett, Charles T., F.C.S., 12, Auriol-road, The Cedars Estate, West Kensington, W.
Kitchin, Archibald, F.C.S., 27, King-street, Whitehaven
Kynaston, Josiah W., F.C.S., St. Helens
Lawes, John Bennet, F.R.S., F.C.S., Rothamstead, St. Alban's
Lawson, G., LL.D., Dalhousie College, Halifax, Nova Scotia
Leebody, J. Robinson, M.A. Magee College, Londonderry
Legg, J. E., Grammar School, Berkhampstead
Leibius, A., Ph.D., F.C.S., Royal Mint, Sydney
Letts, Edmund Albert, Queen's College, Belfast
Lewin, George, Laboratory, Somerset-house, W.C.
Liveing, George Downing, M.A., F.C.S., Cambridge
Liversedge, A., Assoc. R.S.M., University, Sydney
Lloyd, F. J., F.C.S., 16, Barbara-terrace, Barnsbury, N.
Lott, F. E., Assoc. R.S.M., Stapenhill, Burton-on-Trent.
Loram, Herbert Y., F.C.S., 1, Mackintosh Lane, Homerton, E.
Louis, H., Assoc. R.S.M., London-road Iron Foundry, London road, Edinburgh
Lovett, William Jesse, 96. Lionel-street, Birmingham
Lowe, Alfred John George, 167, Fenchurch-street, E.C.
Lowe, W. Foulkes, F.C.S., Assoc. R.S.M., Cambrian View, Chester
Lucas, R., 5, Sydney Terrace, Kilburn, N.W.
Luff, A. P., 13, Lisson-street, Marylebone-road, N.W.
Lupton, Sidney, F.C.S., The Harehills, Leeds.
Lyon, Isidore Bernadotte, Grant Medical College, Bombay.
Lyon, John George, Pontefract.
Lyte, F. Maxwell, F.C.S., Cotford, Oakhill-road, Putney, S.W.
Macadam, W. Ivison, F.C.S., Surgeons' Hall, Edinburgh
Macadam, Stevenson, Ph.D., F.R.S.E., F.C.S., Edinburgh
Macallan, J., Laboratory, Royal College of Surgeons. Dublin
McAlley, R., Chemical Laboratory, Falkirk, Scotland
MacCarthy, John, Port of Spain, Trinidad
Macdougald, G. D., 41, Reform-street, Dundee
Mackenzie, G. S., Ph.D., 23, Deangate, Dundee
MacNamara, J. M., 46, Great College street, Brighton
Mactear, James, F.C.S., St. Rollox, Glasgow
Makins, George Hogarth, F.C.S., Walton-on-Thames
Manning, F. A., F.C.S., 18, Billiter-street, E.C.
Marcet, W., M.D., F.R.S., F.C.S., Athenæum Club, Pall-mall, W.
Marreco, A. F., F.C.S., College of Physical Science, Newcastle-on-Tyne
Marsden, R. Sydney, D.Sc., F.R.S.E., F.C.S., Tapton Grove, Sheffield
Maskelyne, Nevil Story, F.R.S., F.C.S., 112, Gloucester-terrace, W.
Mathew, W. E. B. de V., Langer House, Felixstowe, Ipswich
Matthey, George, F.C.S., 78, Hatton-garden, E.C.
McLeod, Herbert, F.C.S., Cooper's-hill, Staines
Meldola, Raphael, F.C.S., 21, St. John-street, Bedford-row, W.C.
Midwinter, E. J. H., Woodlands, Gloucester Road, New Barnet
Miller, F. Bowyer, F.C.S., Royal Mint, Melbourne
Miller, J., 381, Dobbies Loan, Glasgow
Mills, E. J., D.Sc., F.R.S., F.C.S., Anderson's College, Glasgow
Mond, Ludwig, F.C.S., Winnington-hall, Northwich
Morfit, Campbell, Ph.D., F.C.S., Melford House, Grove End-road, N.W.
Morgan, Thomas M., Victoria College, Jersey
Moss, John, F.C.S., Hirdir Lodge, Salisbury Park, Wrexham
Moss, R. J., Laboratory, Royal College of Surgeons, Dublin
Morrison, R. Milner, D.Sc., 13, Douglas-crescent, Edinburgh
Mucklow, John Davies, F.C.S., 34, Penn-road, N.
Müller, Hugo, Ph.D., F.R.S., F.C.S., 110, Bunhill-row, E.C.
Muspratt, E. K., F.C.S., Seaforth-hall, near Liverpool
Muter, J., Ph.D., F.C.S., Winchester House, Kennington-road, S.E.
Napier, J., F.C.S., Gipping-cottage, Bramford near Ipswich
Neison, Edmund, F.C.S., Scientific Club, Savile-row, W.
Newlands, J. A. R., F.C.S., 18, Josephine-avenue, Brixton-rise, S.W.
Newlands, B. E. R., F.C.S., Clyde-wharf, Victoria-dock, E.
Newth, G. S., New College, Hampstead
Nicholson, E. Chambers, F.C.S., Carlton-house, Herne-hill
Nicholson, Edward, M.D., F.C.S., St. Thomas Mount, Madras
Nickels, Benjamin, F.C.S., Sudbury, Harrow
Nimmo, James. 17, Great Tower-street, E.C.
Odling, W., M.B., F.R.S., F.C.S., 15, Norham-gardens, Oxford
Odling, Walter, F.C.S., Burton-on-Trent
Ogilvie, Thomas Robertson, F.C.S., 13, Forsyth-street, Greenock
Ogston, G. H., F.C.S., 3, St. James-street, S.W.
O'Keefe, C., Laboratory, Queen's College, Cork
Ollerenshaw, Samuel, Sutton Alkali Works, St. Helens
O'Neill, Charles, F.C.S., 72, Denmark-road, Manchester
O'Sullivan, C., F.C.S., 140, High-street, Burton-on-Trent
Packer, George Smithers, F.C.S., Cambuslang, by Glasgow
Page, David, M.D., F.C.S., Netherfield, Kendal, Westmoreland
Page, F. J. M., B.Sc., F.C.S., Assoc. R.S.M., University College, W.C.
Parker, John Spear, 297, Western-road, Sheffield
Parkinson, Robert, Ph.D., Bradford
Patterson, T. Law, F.C.S., Belmont, Margaret-street, Greenock
Pattinson, John, F.C.S., 75, The Side, Newcastle-upon-Tyne
Paul, B. H., Ph.D., F.C.S., 1, Victoria-street, Westminster, S.W.
Pearce, G. A., B.A., M.B., F.C.S., Northumberland House, High-road, Lee, S.E.
Pearce, Walter, B.Sc., F.C.S., Assoc. R.S.M., Maidenhead
Pedler, Alexander, F.C.S., Presidency College, Calcutta
Perkin, W. H., F.R.S., F.C.S., The Chestnuts, Sudbury
Phillips, A. G., 20, Canning-street, Liverpool
Phillips, J. A., C.E., F.C.S., 18, Fopstone-road, Kensington, W.
Piesse, C. H., 7, Moore Park Villa, Fulham-road, S.W.
Plowman, Sydney, Residences, St. Thomas's Hospital, S.E.
Pochin, Henry Davies, F.C.S., Barn Elms, Barnes, S.W.
Prévost, E., Ph.D., F.C.S., Royal Agricultural College, Cirencester
Price, Astley P., Ph.D., F.C.S., 47, Lincoln's-inn-fields, W.C.
Price, David S., Ph.D., F.C.S., 26, Great George-street, W.
Procter, W. Wilson, 33 and 35, Side, Newcastle-on-Tyne
Purdie, T., jun., B.Sc., F.C.S., Assoc. R.S.M., Ardenlee, Lanark
Ramsey, William, Ph.D., F.C.S., University College, Bristol
Reddrop, Joseph, F.C.S., London and North Western Railway, Crewe
Redwood, T., Ph.D., F.C.S., 17, Bloomsbury-square, W.C.
Redwood, T. Boverton, F.C.S., Fairlawn, North Finchley, Middlesex
Rennie, E. H., B.Sc., (Lond.) Seaforth-lodge, 38, Maida-vale, W.
Reynolds, J. Emerson, M.D., F.C.S., Trinity College, Dublin
Reynolds, W. J., M.A., F.C.S., Royal Military Asylum, Chelsea, S.W.
Rich, Sidney W., 34, Gloucester-road, Croydon
Richards, Edward, Assoc. R.S.M., Barrow-in-Furness
Riley, Edward, F.C.S., 14a, Finsbury-square, E.C.
Rimmington, George, 9, Bridge-street, Bradford
Roberts, T. V., 4, Alfred-road, Handsworth, near Birmingham
Roberts, W. C., F.R.S., Royal Mint, Tower Hill, E.C.
Robinson, John, F.C.S., 13, Devon Square, Newton Abbot
Robinson, G. Carr, F.R.S.E., Royal Institution, Hull
Robson, Thomas S., 57, Side, Newcastle-on-Tyne
Rocholl, Heinrich, Middlesbro-on-Tees
Rodwell, George Farrer, F.C.S., Marlborough College
Ronalds, E., Ph.D., F.R.S.E., Bonnington-house, Edinburgh
Roscoe, H. E., Ph.D., F.R.S., F.C.S., Owen's College, Manchester
Rosenthal, G., Ph.D., Wandsworth-bridge-wharf, Fulham, S.W.
Roy, Taraprosanna, Chemical Examiner, Medical College, Calcutta
Russell, W. J., Ph.D., F.R.S., St. Bartholomew's Hospital, E.C.

Ryan, Dennis, The School of Medicine, Liverpool
Salter, Mortyn John, F.C.S., 112, Forest-road, Dalston, E.
Savery, T. J., 11, Salisbury Square, E.C.
Schunck, E., Ph.D., F.R.S., F.C.S., Kersall, near Manchester
Sell, William James, B.A., 1, Benet-place, Cambridge
Senier, A., M.D., F.C.S., 17, Bloomsbury Square, W.C.
Shadwell, J. E. S., Meadow Bank, Melksham, Wilts
Shenstone, William Ashwell, F.C.S., Clifton College, Bristol
Shepherd, H. H. B., F.C.S , Shirley House, Charnock-road, Clapton, E.
Sheppard, Thomas Williams, M.D., Patna, Bengal
Sieber, C. H., 64, Corporation-street, Manchester
Siebold, Louis, F.C.S., Oxford Street, Manchester
Siemens, C. W., D.C.L., F.R.S., F.C.S., 12, Queen Anne's-gate, S.W.
Slatter, G. W., Saltaire, near Bradford, Yorkshire
Smee, A. H., F.C.S., The Grange, Wallington, Carshalton, Surrey
Smith, Arthur Percy, F.C.S., Temple Observatory, Rugby.
Smith, R. Angus, Ph.D., F.R.S., F.C.S., 22, Devonshire-st., Manchester
Smith, Watson, F.C.S., Owens College, Manchester
Snelus, George James, F.C.S., Assoc. R.S.M., Workington
Sonstadt, E., F.C.S., 4, Hartham-road, Camden-road, N.
Spiller, John, F.C.S., 2, St. Mary's-road, Canonbury, N.
Spiller, William, F.C.S., Atlas Works, Hackney-wick, N.E.
Stead, John Edward, Middlesbrough
Steuart, Daniel Rankin, Broxburn, Scotland
Stevenson, J. Cochran, M.P., F.C.S., Westoe, South Shields
Stevenson, Thomas, M.D., F.C.S., Laboratory, Guy's Hospital, S.E.
Stewart, A. Young, F.C.S., 212, Camden Road, N.W.
Stock, William Frederick Keating, F.C.S., Darlington
Stoker, George Naylor, Laboratory, Somerset-house, W.C
Sutton, Francis, F.C.SS., Norwich
Swan, J. Wilson, F.C.S., Moseley-street, Newcastle-on-Tyne
Szczepanowski, Stanislas A. Prus., F.C.S., 6, Stafford-place, Buckingham-gate, S.W.
Tate, Alexander Norman, 7, 9, and 11, Hackin's Hey, Liverpool
Tate, Walter, Norwood Grove, Liverpool
Tatlock, J., 138, Bath-street, Glasgow
Tatlock, Robert R., F.C.S., 138, Bath-street, Glasgow
Taylor, J., F.C.S., Farmers' Club, Inns of Court Hotel, Holborn, E.C.
Taylor, R. L., F.C.S., 52, Great Cheetham-street, Broughton, Manchester
Thomas, Joseph William, F.C.S., Pen-y-lan, Cardiff
Thomson, John Millar, F.C.S., King's College, W.C.
Thomson, William, F.C.S., Royal Institution, Manchester
Thorp, W., B.Sc., F.C.S., 39, Sandringham-road, West Hackney, N.E.
Tichborne, Charles, R.C., M.R.I.A., F.C.S., 40, Mary-street, Dublin
Tidy, Charles Meymott, M.B., F.C.S., 3, Mandeville-place, Manchester-square, W.
Tilden, W. A., D.Sc., F.C.S., Mason's Science College, Birmingham
Tomlinson, Charles, F.R.S., F.C.S., 3, Ridgmount-terrace, Highgate
Tookey, Charles, F.C.S., The Museum, Jermyn-street, W.
Tribe, Alfred, F.C.S., Dulwich College
Tucker, Alexander E., The Rhymney Iron Works, Rhymney, South Wales
Tuson, Richard V., F.C.S., Royal Veterinary College, N.W.
Tyrer, Thomas, F.C.S., Garden Wharf, Battersea, S.W.
Umney, Charles F.C.S., 50, Southwark-street, S.E.
Vacher, Arthur, F.C.S., 12, Fitzroy-street, W.
Versmann, Frederick, Ph.D., 15, Trinity-square, Great Tower-st., E.C.
Viccajee, K. R., 10, Churney-road, Bombay
Vincent, Charles W., F.R.S.E., F.C.S., Royal Institution, Albemarle-street, W., and 23, Harvist Road, Holloway, N.
Vinson, W. E., Gloucester Gas Light Company, Gloucester
Voelcker, A., Ph.D., F.R.S., 39, Argyle-road, Kensington, W.
Voelcker, E. W., Analytical Laboratory, 11, Salisbury Square, E.C.
Walenn, W. H., F.C.S., Delmar Villa, 520, Caledonian-road, N.
Walker, J. F., M.A., F.C.S., Sidney Sussex College, Cambridge
Wallace, William, Ph.D., F.R.S.E., 138, Bath-street, Glasgow
Walton, T. U., 63, Newton-street, Greenock
Ward, G., F.C.S., Buckingham-terrace, Headingly, Leeds
Warington, Robert, F.C.S., Harpenden, Herts
Watt, Alexander, F.C.S., 24, Thackery-street, Liverpool
Watson, David, D.Sc., F.C.S., Assoc. R.S.M., Broughton Copper Works, Manchester
Watts, John, D.Sc., F.C.S , University Laboratory, Oxford
Way, John Thomas, F.C.S., 9, Russell-road, Kensington, W.
Weldon, Walter, F.C.S., Rede-hall, Burstow, Surrey
Wells, G. I. J., Lugsdale Chemical Works, Widnes
Westmoreland, W. J., Bowling Iron Works, Bradford, Yorkshire
Whewell, George, F.C.S., Exchange-chambers, Blackburn
Whiffen, William George, Lombard-road, Battersea
Wigner, G. W., 79, Great Tower-st., E.C.
Williams, John, F.C.S., 16, Cross-street, Hatton-garden, E.C.
Williams, M. Witley, F.C.S., 18, Kempsford-gardens, Brompton, S.W.
Williams, William John, F.C.S., 20, Chichester-street, Chester
Williamson, Robert, F.C.S , Messrs. Burt, Bolton, and Heywood, Silvertown, E.
Wilson, George Ferguson, F.R.S., F.C.S., Heather-bank, Weybridge
Wilson, James Henry, Oak Hall, East Ham, Essex
Wilson, William V., F.C.S., Jubilee street, Mile-end, E.
Winser, Percy James, F.C.S., Marsden-street, Manchester
Witton, J. C., B.A., B.Sc., Grammar School, Andover, Hampshire
Wood, Charles Henry, F.C.S., 46, Loraine-road, Holloway, N.
Wood, G. W., A.K.C., F.C.S., 12, Hope-park, Bromley, Kent
Wood, W. H., Northgate Chambers, Halifax
Woodcock, Reginald C., F.C.S., 23, Abingdon Street, Westminster.
Wright, C. R. Alder, D.Sc., F.C.S., St. Mary's Hospital, W.
Young, James, F.R.S., F.C.S., Kelly, near Greenock
Young, William Charles, F.C.S., Plaistow, Essex

ASSOCIATES.

Arnold, A. E., 7, Jeffreys-square, E.C.
Bascombe, Frederick, 180, New Bond-street, W.
Bayne, James, F.C.S., Royal Veterinary College, N.
Beckett, G. H., F.C.S., 277, Edgware road, W.
Bendix, David, F.C.S., Prince Regent's Wharf, Victoria Docks, E.
Billing, H. S., Messrs. Burnard, Lack, and Alger, Plymouth Chemical Works, Plymouth
Carpenter, H. S., F.C.S., Weighton-road, Anerley, S.E.
Copley, James, Gregory-street, Nottingham
Cowper, Richard, F.C.S., Assoc. R.S.M , 3, The Residences, South Kensington Museum, W.
Davey, G.W., 8, Hawthorn-terrace, Barking, Essex
Davidson, James, Junr., Summerville, near Dumfries
Dobbin, Leonard, Chemical Laboratory, University, Edinburgh
Firby, Alfred, 2, Fallowfield-terrace, Leeds
Gahan, William Patrick, Bishop's Stortford, Herts
Gaskell, Francis, Newnham-lodge, Spring-grove, Isleworth
Gill, Edward J. G, 59, King Henry's-road, N.W.
Gibson, John, Ph.D., F.R.S.E., 29, Greenhill-gardens, Edinburgh
Graham, C. C., Silwood, Tulse Hill, S.W.
Greenish, Henry George, 20, New-street, Dorset-square, N.W.
Haddock, A., Runcorn Soap and Alkali Co., Limited, Weston, near Runcorn
Hellon, R., Assoc.R.S.M., 12, Route du Landi, St. Denis, Paris
Hollis, Percy Best, Borax and Alkali Works, Widnes
Holmes, Frederick George, 46, Hill-street, Peckham, S.E.
Hooker, Ayerst Henham, Court-Lodge, Lessness-heath, S.E.
Hughes, Hugh, 81, Troughton-street, Edgehill, Liverpool
Hutchinson, T. J., Lower Croft Bleach Works, Elton, near Bury
Jago, William, F.C.S., School of Science and Art, Brighton
Jobson, Thomas, junr., Stocksbridge Works, near Sheffield
Jude, K. H., D.Sc., 37, Kempsford-gardens, South Kensington
Lapraik, William, F.C.S., Chemical Laboratory, St. Bartholomew's Hospital
MacIvor, R.W. Emerson, 29, Queen-street, Melbourne
McGowan, George A., 22, East Claremont-street, Edinburgh
Matthews, C. G., F.C.S., St. John's-lodge, Beckenham
Naigamvala K. D., 35, Malabar Hill, Bombay
Neison, Cuthbert Gordon, Royal Veterinary College, N.W.
Paterson, George, 93, Canning Street, Liverpool
Paterson, W. G. Spence, 24, Pitt-street, Edinburgh
Patterson, George, 73, Nicholson-street, Greenock
Pearson, Alfred Naylor, Victoria and Albert Museum, Bombay
Powell, L. S., F.C.S , 56, St. James-square, Notting-hill, W.
Sear, Frederick, 17, Rodney-street, Pentonville, N.
Senier, Harold, F.C.S., 5, Romola-terrace, Norwood-lane, Tulse-hill, S.E.
Smetham, Alfred, F.C.S., 18, Brunswick-street, Liverpool
Smith, Henry Russell, 1, Aubert-park, Highbury-park, N.
Starling, John H., F.C.S., The Avenue, Erith
Thorne, Leonard Temple, 52, Fortess-road, Kentish-town, N.W.
Toms, F. Woodland, F.C.S., 7, Busby-place, Camden-road, N.W.
Walker, Henry Herbert, 341, Glossop-road, Sheffield.
Williams, P. Caradoc, 6, Parliament-place, Liverpool

Members are requested to send notice of change of address, &c., to the Secretary, Mr. Charles E. Groves, Somerset-house-terrace, W.C.

SOCIETY FOR THE ADVANCEMENT OF CHEMICAL INDUSTRY.

A Meeting, for the purpose of forming a Society for the Advancement of Chemical Industry, will be held on Monday, April 4th, 1881, in the rooms of the Chemical Society, Burlington House, Piccadilly, London, W., at 4 p.m.

Prof. Roscoe, F.R.S., President of the Chemical Society, will occupy the chair.

All persons interested in the Chemical Industries are hereby invited to attend.

GEORGE E. DAVIS, Hon. Sec. *pro tem.*

AMMONIACAL LIQUOR.

THE DIRECTORS OF THE BRISTOL UNITED GAS LIGHT COMPANY invite TENDERS for the PURCHASE of the AMMONIACAL LIQUOR made at all or either of their THREE STATIONS, situate respectively at AVON STREET, CANONS' MARSH, and STAPLETON ROAD in the Borough of Bristol, for a TERM of FIVE or SEVEN YEARS, commencing on 1st JULY, 1882.

The Annual Quantity of Liquor produced at present at the three Stations is about 2½ millions of gallons.

Conditions of Contract and other particulars may be obtained of the SECRETARY, at the Office of the Company, Canon's Marsh, Bristol.

Tenders to be delivered on or before TUESDAY, 3rd day of May next, addressed to the Chairman of the Company, and marked 'Tender for Ammoniacal Liquor."

The Directors do not bind themselves to accept the highest or any Tender.

HENRY H. TOWNSEND, Secretary.

Gas Offices, Canons' Marsh, Bristol,
8th January, 1881.

THE CHEMICAL NEWS.

Vol. XLIII. No. 1113.

ON THE CALORIFIC POWER OF FUEL, AND ON THOMPSON'S CALORIMETER.

By J. W. THOMAS, F.C.S., F.I.C.

A simple experiment, capable of yielding results which shall be at least comparative, has long been sought after by large consumers of coal and artificial fuel abroad in order to ascertain the relative calorific power possessed by each description, as it is well known that the proportion of mineral matter and the chemical composition of coal differs widely. The determination of the ash in coal is not a highly scientific operation ; hence it is not surprising that foreign merchants should have become alive to the importance of estimating its quantity. While, however, the nature and quantity of the ash can be determined without much difficulty, the determination of the chemical composition of coal entails considerable labour and skill ; hence a method giving the calorific power of any fuel in an exact and reliable manner by a simple experiment is a great desideratum. This will become more obvious when one takes into consideration the many qualities and variable characters of the coals yielded by the South Wales and North of England coal fields. Bituminous coals—giving some 65 per cent of coke—are preferred for some manufacturing purposes, and in some markets. Bituminous steam coals, yielding 75 per cent of coke, are highly prized in others. Semi-bituminous steam coals, yielding 80 to 83 per cent of coke, are most highly valued, and find the readiest sale abroad ; and anthracite steam coal (dry coals), giving from 85 to 88 per cent of coke (using the term "coke" as equivalent to the non-volatile portion of the coal) is also exported in considerable quantity. Now the estimation of the ash of any of these varieties of coal would afford no evidence as to the class to which that coal belongs, and there is no simple test that will give the calorific power of a coal, and at the same time indicate the degree of bituminous or anthracitic character which it possesses. In order to obtain such information it is necessary that the percentage of coke be determined together with the sulphur, ash, and water, and these form data which at once show the nature of a fuel and give some indication of its value. To ascertain the quantity of the sulphur, ash, and water with accuracy involves more skill and aptitude than can be bestowed by the non-professional public ; the consequence is that experiments entailing less time and precision, like those devised by Berthier and Thompson, have been tried more or less extensively. In France and Italy, Berthier's method—slightly modified in some instances—has been long used. It is as follows :—

70 grms. of oxide of lead (litharge) and 10 grms. of oxychloride of lead are employed to afford oxygen for the combustion of 1 grm. of fuel in a crucible. From the weight of the button of lead, and taking 8080 units as the equivalent of carbon, the total heat-units of the fuel is calculated. This experiment is very imperfect and erroneous upon scientific grounds, since the hydrogen of the fuel is scarcely taken into account at all. In the first place, hydrogen consumes only one-quarter as much oxygen as carbon, and, furthermore, two-ninths only of the heating power of hydrogen is used as the multiplying number, viz., 8080, whilst the value of hydrogen is 34,462. In other words, one-eighteenth only of the available hydrogen present in the fuel is shown in the result obtained. Apart from this my experience of the working of Berthier's method has been by no means satisfactory. There is considerable difficulty in obtaining pure litharge, and it is almost impossible to procure a crucible which does not exert a reducing action upon the lead oxide. Some twelve months ago I went out to Italy to test a large number of cargoes of coal with Thompson's calorimeter, and since then this apparatus has superseded Berthier's process, and is likely to come into more general use. Like Berthier's method, Thompson's apparatus is not without its disadvantages, and the purpose of this paper is to set these forth, as well as to suggest an uniform method of working by means of which the great and irreconcilable differences in the results obtained hy some chemists might be overcome. It has already been observed that a coal rich in hydrogen shows a low heating power by Berthier's method, and it will become evident on further reflection that the higher the percentage of carbon the greater will be the indicated calorific power. In fact a good sample of anthracite will give higher results than any other class of coal by Berthier's process. With Thompson's calorimeter the reverse is the case, as the whole of the heating power of the hydrogen is taken into account. In short, with careful working, the more bituminous a coal is the more certain is it that its full heating power shall be exerted and recorded, so far as the apparatus is capable of indicating it; for when the result obtained is multiplied by the equivalent of the latent heat of steam the product is always below the theoretical heat units calculated from the chemical composition of the coal by the aid of Favre and Silbermann's figures for carbon and hydrogen. On the other hand, when the heating power of coal low in hydrogen is determined by Thompson's calorimeter, much difficulty is experienced in burning the carbon completely ; hence a low result is obtained. From a large number of experiments I have found that when a coal does not yield more than 86 per cent of coke, it gives its full comparative heating power, but it is very questionable if equal results will be worked out if the coke exceeds the above amount, although I have met with coals giving 87 per cent of coke, which were perfectly manageable, though in other cases the coal did not burn completely. It will be noted that the non-volatile residue of anthracite is never as low as 86 per cent, and this, together with the very dry steam coals and bastard anthracite (found over a not inextensive tract of the South Wales Coal Field), form a series of coals, alike difficult to burn in Thompson's calorimeter. Considerable experience has shown that in no single instance was the true comparative heating power of anthracite or bastard anthracite indicated. With a view to accelerate the perfect combustion of these coals, sugar, starch, bitumen, and bituminous coals—substances rich in hydrogen—were employed, mixed in varying proportions with the anthracitic coal, but without the anticipated effect. Coke was also treated in a like manner. Without enlarging further upon these futile trials—all carefully and repeatedly verified—the results of my experiments and experience show that for coals of an anthracitic character, yielding more than 87 per cent of coke, or for coke itself, Thompson's calorimeter is not suited as an indicator of their comparative calorific power for the simple reason that some of the carbon is so graphitic in its nature that it will not burn perfectly when mixed with nitrate and chlorate of potash. A sample of very pure anthracite used in the experiments referred to, gave 90·4 per cent of non-volatile residue, and only 0·84 per cent of ash. This coal was not difficult to experiment with, as combustion started with comparative ease and proceeded quite rapidly enough, but in every instance a portion of the carbon was unconsumed, and consequently instead of about 13° of rise in temperature only 10° were recorded.

Since the calorific power of a coal is determined by the number of degrees Fahrenheit which a given quantity of water is raised in temperature by a known weight of fuel, it follows that every care should be taken that the experiment be performed under similar atmospheric conditions. The oscillation of barometric pressure does not appear to affect the working, but the temperature of the room in which the work is done, and especially that of the water, are most important considerations. It has been observed by some who have used this apparatus—and I have frequently noticed it myself—that the lower the temperature of the water is under which the fuel is burnt the higher is the result found. This has been explained on the assumption that the colder the water used, the greater is the difference between the temperature of the room and that of the water; hence it would be expedient that in all cases when such experiments are made the same difference of temperature between the air in the room and the water employed should always exist. For example, if the temperature of the room were 70°, and the water at 60°, then the same coal would give a like result with the water at 40° and the room at 50°. This has been regarded as the more evident, because the gases passing through the water escape under favourable conditions of working at the same temperature as the water, and are perfectly deprived of any heat in excess of that possessed by the water. Under these circumstances it would seem only reasonable that this assumption should be correct. It was, however, found after a large number of experiments upon the same sample of coal that this was not the case. 30 grs. of coal which rises the temperature of the water 13·4°, when the water at starting was 60° and the room at 70°, gives 13·7° rise of temperature with the water at 40° and the room at 50°. Conversely, when the water is at 70° and the room at 80°, a lower result is obtained. The explanation appears to be this:—The gas which escapes from the water was not in existence in the gaseous form previous to the experiment, and the heat communicated to the gas being a definite quantity it follows that the more the gas is cooled the greater the proportion of chemical energy in the shape of heat will be utilised and recorded as calorific power.

In order, therefore, to make the experiment more simple and workable at all temperatures, a sample of coal was selected, which should be perfectly manageable and readily consumed. Appended is an analysis of the coal employed (from Ebbw Vale, Monmouthshire):—

	Composition per cent.
Carbon	88·33
Hydrogen	5·08
Oxygen	3·28
Nitrogen	0·55
Sulphur	0·70
Ash	1·26
Water (moisture)	0·80
	100·00

In the following experiments the standard temperature of the water was taken as 60° F., and as the coal gave 13·4° of rise of temperature, 67° F. was selected as the standard room temperature. The reason for this room temperature is obvious, for, whatever heating effect the higher temperature of the room may have upon the water in the cylinder during the time occupied by the first half of the experiment, would be compensated for by the loss sustained during the second half of the experiment, when the temperature of the water exceeded that of the room. The mean of numerous trials gave 13·4° F. rise of temperature, equal to 14·74 lbs. of water per lb. of coal. When the water was at 50° and the room at 57°, the mean of several experiments gave 13·5° rise of temperature. When the water was 40° at starting and the room at 47°, 13·65° was the average rise of temperature. Trials were made at intermediate temperatures, and the results always showed that higher figures were recorded when the water was coldest. With a view of getting uniformity in the results it was thought well to make experiments, in order to find out what temperature the room should be at, so that this coal might give the same result with the water at 50°, 40°, or at intermediate temperatures. Without going much into detail, it was found that when the temperature of the room was at 40° and that of the water 40°, and the experiment was rapidly and carefully performed, 13·4° rise of temperature was given; but this result could be obtained without special effort when the room was 42° and the water 40° at starting. It is evident that the cooling effect of the air in the room upon the water cylinder is very appreciable when the water has reached 13° above that of the room. When the water was at 50° and the room at 55°, the coal gave 13·4° rise with ease and certainty, and it would not be out of place to remark here that with those coals which burn well in Thompson's calorimeter, the results of several trials are remarkably uniform when properly performed. With the water at 70° and the room at 80°, a like result was worked out. Experiments at intermediate temperatures were also carried out (see table in sequel). It is true that the whole difference of temperature we are dealing with in making these corrections is only 0·25, but 0·2 in the result, when multiplied by 537 to bring it into calories, as is done by the authorities in Italy, makes more than 100 heat units—a serious difference when 5d. per ton fine is attached to every 100 calories lower than the number guaranteed.

Taking the latent heat of steam as 537° C., and multiplying this number by 14·74, the evaporative power of the coal used in these experiments, its equivalent in calories is 7915. From the analysis of this coal, disregarding the nitrogen and deducting an equivalent of hydrogen for the oxygen present, the *total heat units* given by Favre and Silbermann's figures for carbon (8080) and hydrogen (34,462) will be 8746. It will be seen, therefore, that the calorific power, as determined by Thompson's apparatus, gives a much lower result when multiplied by 537 than the heat units calculated from the chemical composition of the coal. When I used Thompson's apparatus in the chemical laboratory at Turin to determine the evaporative power of various cargoes of South Wales coal, it was agreed by mutual consent that the temperature of the water at starting should be 39° F. (the temperature at which the *heat unit* was determined). The temperature of the room was about 60°, but this varied, as the weather was somewhat severe and changeable. Under these conditions with the water at 39° and room 60°, the coal which gives 14·74 lbs. of water per lb. of coal, will give as high as 15·88 lbs. of water per lb. of coal. This result multiplied by 537 = 8496 calories, approaching much more nearly to the theoretic value. This method of working is still practised abroad, but experience has shown that very widely differing results follow when working in this manner, especially if the temperature of the room is changeable, as it naturally is where ash determinations and other chemical work is proceeding simultaneously. The time the experiment lasts, taking the reading on a quickly rising thermometer and other considerations, render the experiments anything but trustworthy when 0·2 of a degree makes a difference of more than 100 calories. In the instructions supplied with Thompson's calorimeter nothing is said as to the temperature of the room in which the experiment is performed, but simply that the water shall be at 60° F. If, with the water at 60°, a room were at 50°, as it often is in winter, a good coal would give 14 lbs. of water per lb. of coal as the evaporative power; but if in summer, the room were at 75° and the water at 60°, the same coal would give 15 lbs. of water per lb. of coal. If further evidence were needed of the effect of temperature a consideration of the experiments already referred to will show how necessary it is that some general rule shall be adopted. Considerable stress is laid (in the instructions) upon the quantity of oxygen mixture used being determined by rough experiments. This I have found leads to erroneous conclusions unless a number of experiments are tried in the calorimeter, as it often happens that the quantity which appears to be best adapted is not that which yields a trustworthy result. There are many samples of South Wales coal, 30 grains of which will require 10 parts of oxygen mixture in order to burn completely, but since a little oxygen is lost in drying and grinding and few samples of chlorate are free from chloride, it is not safe to use less than 11 parts of oxygen mixture, but this amount is sufficient in *all* cases, and never need be exceeded. I have made numerous experiments with various coals (anthracite, steam, semi-bituminous, and bituminous, including a specimen of the ten yard coal of Derbyshire), and find that with 11 parts of chlorate and nitrate of potash, they are all perfectly manageable and yield the best results. It is quite clear that the excess of chlorate is decomposed in all instances, and the latent heat of the oxygen evolved, but those coals which are best to experiment with did not yield results that differed when the quantity of oxygen mixture was reduced to nearly the limit required for combustion of the coal. Under these circumstances, therefore, the constant use of 11 parts of oxygen mixture—a suitable quantity for all coals exported—would enable operators to obtain similar figures, and make the test uniform in different hands.

The following is a brief outline of the method of procedure recommended:—Sample the coal until an average portion passes through a sieve having 64 meshes to the square inch. Take about 300 grains (20 grms.) of this and run through a brass wire gauze having 4600 meshes to the square inch, taking care that the whole sample selected is thus treated. One part of nitrate of potash and 3 parts of chlorate of potash (dry) are separately ground in a mortar, and repeatedly sifted through another wire gauze sieve, having 1000 meshes to the square inch, in order that the oxygen mixture shall *not* be ground to an impalpable powder, as this is very undesirable. It absorbs moisture rapidly, and interferes with the regularity of the combustion when very fine. 330 grains of the powder are weighed out (after drying), and intimately incorporated with 30 grains of coal—better with a spatula than by rubbing in a mortar—and then introduced into a copper cylinder (3½ ins. long by ¾ in. wide, made from a copper tube), and pressed down in small portions by a test-tube with such firmness as is required by the nature of the coal, not tapped on the bottom, since the rougher portions of the oxygen mixture rise to the surface. As the temperature of a room is almost invariably much higher than the water supply, a little hot water is added to that placed in the glass cylinder, until the difference of temperature between the water and the room is about the mark indicated in the following table:—

Room at	The Water should be
80° F.	70° F.
72	64
67	60
60	54
55	50
50	46
42	40

Say, for example, the room was at 57° and the water placed in the cylinder was at 46°: add a little hot water and stir with the thermometer until it assumes 52°. By the time the excess of water has been removed with a pipette until it is exactly level with the mark, and all is ready, the temperature will rise nearly 0·5°. Let the thermometer be immersed in the water at least three minutes before reading. The fuse should be placed in the mixture, and everything at hand before reading and removing the thermometer. After igniting the fuse and immersing the copper cylinder in the water, the apparatus should be kept in the best position for the gases to be evolved all around the cylinder, and the rate of combustion noted. Some coals are very unmanageable without practice, and samples of "Patent Fuel" are sometimes met with, containing unreasonable proportions of pitch, which require some caution in working and very close packing, inasmuch as small explosions occur during which a little of the fuel escapes combustion.

In order that the experiment shall succeed well, experience has shown that the nature of the fuse employed has much to do with it. Plaited or woven wick is not adapted, and will fail absolutely with dry coals, unless it is made very free burning. In this case not less than three-quarters of an inch in length is necessary, and the weight of such is very appreciable. I always use Oxford cotton, and thoroughly soak it in a moderately strong solution of nitrate of potash. When dry it should burn a little too fast. The cotton is rubbed between two pieces of cloth until it burns just freely enough; then four cotton strands are taken, twisted together, and cut into lengths of ¾ in. and thoroughly dried. Open out the fuse at the lower end when placing it in the mixture so as to expose as much surface as possible in order to get a quick start, but carefully avoid pressing the material, and use a wire to fill up close to the fuse A slow start often spoils the experiment, through the upper end of the cylinder becoming nearly filled up with potassic chloride, &c.

By paying attention to such details, and following the method recommended, the apparatus yields very satisfactory results with bituminous and semi-bituminous coals.

The Laboratory, Cardiff,
March 8, 1881.

ON DETERMINATIONS OF AMMONIA IN WATER ANALYSIS.

By WILLIAM HENRY WATSON, F.C.S.

When examining waters by the ammonia process it is frequently requisite, owing to the presence of suspended matters in the samples, to filter the water previous to distillation, and it therefore occurred to me to determine whether the amount of ammonia, usually described as "free" ammonia, is noticeably affected by this procedure. Naturally we might expect to find the simple removal of suspended matters to affect only that portion of the ammonia given off after treatment with alkaline solution of potassium permanganate, but I have found in several instances the amount of free ammonia to be considerably lessened also. The following results were obtained:—

1. Sample of water containing 4·26 grs. of flocculent suspended matter per gallon, of which 3·18 remain after ignition.

	Parts per Million.
Free ammonia before being filtered.. ..	0·430
,, ,, after ,, ,, ...	0·370
,, ,, removed by filtration ..	0·060

2. Sample of water containing 3·05 grs. of suspended matter of which 1·50 remain after ignition.

Free ammonia before filtering..	0·318
,, ,, after ,, ...	0·250
Difference	0·068

In the instance of waters in which there was no suspended matter, I have not found any appreciable diminution in the amount of free ammonia by filtration. It is therefore evident that the suspended matter removed by filtration, as in the experiments quoted, carries some of the ammonia absorbed in its substance.

A fresh series of experiments was made by infusing pieces of fresh beef in water, and by keeping the infusion for several days until decomposition had begun. A flocculent substance, after six days' standing, was formed in the infusion, after which the ammonia determinations were made before and after filtering, with the following results:—

	Parts per 1000.	
	Before.	After.
Experiment 1...	0·050	0·038
,, 2...	0·048	0·038
,, 3...	0·053	0·040

No doubt the proportion of ammonia in this way absorbed from water and capable of being removed with suspended matter, depends upon the nature of the suspended matter both chemically and physically. However, it would appear desirable to make it a rule that, in waters containing matters in suspension, separate quantities of water should be taken for the determinations of "free" and "albumenoid" ammonia respectively. Thus the original unfiltered water should be employed for free ammonia, while the water previously filtered should be taken for the albumenoid ammonia; no note being necessary of the free ammonia in the latter case.

Analytical Laboratory, The Folds, Bolton.

ON THE ANALYSIS OF BISULPHIDE OF CARBON.

By H. MACAGNO.

When carbon disulphide is gradually added to a solution of potash in absolute alcohol, potassium xanthate is formed, according to the following equation:—

$$C_2H_5HO + KHO + CS_2 = KC_2H_5COS_2 + H_2O.$$

This alcoholic solution, saturated with acetic acid, and treated with a drop of cupric sulphate, gives a brownish precipitate of cupric xanthate, which quickly changes to bright yellow flocks of cuprous xanthate. This salt is insoluble in water, and in dilute acids.

The formation of cuprous xanthate has been employed for detecting carbon disulphide in coal-gas, the gas being passed through alcoholic potash. The same reaction, I think, could be very useful to analyse commercial disulphide of carbon or in estimating the quantity of this compound in soil air, when it is employed as a remedy for the *phylloxera*. To the end of obtaining a quantitative method, I endeavoured to determine in cuprous xanthate the quantity of copper, corresponding to carbon disulphide employed.

Four assays on 100 c.c. of an alcoholic solution, containing 1 grm. of carbon disulphide per litre, give me the following quantity of cupric oxide (CuO), burnt in a platinum crucible:—

0·0526 grm.
0·0520 ,,
0·0516 ,,
0·0512 ,,

Mean result, CuO = 0·0518 grm. for 0·10 grm. disulphide.

Very troublesome would be analysis in this way, for which much time and many delicate manipulations are requisite. For it, I undertook some researches on a volumetric process.

A drop of potassium ferrocyanide spread on a clean white plate and touched by a small glass rod, moistened with neutral and alcoholic solution of potassium xanthate, gives a perfectly white compound: but if xanthic acid has been precipitated as cuprous xanthate, and a slight amount of cupric sulphate is present, the ferrocyanide drop becomes red-brown, for the well-known precipitate of cupric salts is produced.

This fact suggests a simple means of determining the whole of the xanthic acid, by decinormal solution of copper, that we can easily prepare by dissolving in a litre of water 12·47 grms. of crystallised cupric sulphate, previously powdered and pressed between blotting-paper. By this method I obtained the following results:—

Carbon Disulphide mixed with Alcoholic Potash Solution. Grm.	Decinormal Solution of Cupric Sulphate. C.c.
0·10	13·2
0·15	19·7
0·20	26·2
0·15	19·8
0·10	13·1
0·30	39·5
1·00	131·5

And from it we deduce that:—

To 1 c.c. of $\frac{n}{10}$ copper solution corresponds 0·0076 grm. of carbon disulphide, viz., $\frac{1}{1000}$th of its molecular weight.

I think this process would render no little service in commercial analysis of carbon disulphide, in order to discover its adulterations with other liquids, and also when we have to estimate the amount of its vapour in gaseous compounds.

Agricultural Station of Palermo, Italy,
February, 1881.

THE ALKALOID FROM PITURIE.*

By Professor LIVERSIDGE, Assoc. R. S. Mines, F.I.C.

(Concluded from p. 126).

Reactions of the Alkaloid.

Neither concentrated hydrochloric acid nor nitric acid changes the colour of the alkaloid in the cold, but when warmed, hydrochloric acid imparts a slightly reddish colour, and nitric acid turns it yellow. Concentrated sulphuric acid turns it brown after some time, immediately when warmed.

Platinic chloride does not precipitate an aqueous solution of the alkaloid (1 : 100 aq) so long as the alkaloid is in excess, but when the solution has become neutralised, the addition of another drop of platinic chloride throws down a slight yellowish flocculent precipitate, which dissolves on heating, but does not reappear on cooling; if a larger quantity of the platinic chloride be added, the precipitate still dissolves on the application of heat, but on cooling reappears in a crystalline condition.

In a solution of 1 part of the hydrochloride of the alkaloid to 50 of water, a precipitate similar to the above is thrown down, and if heated, a part re-dissolves, the undissolved portion turns to an orange-yellow colour and becomes crystalline—the dissolved salt also crystallises only on cooling. Under the microscope the crystals appear to have the form of the octahedron, or combinations of that with other forms belonging to the cubical system. More dilute solutions of the hydrochloride are not precipitated by platinic chloride.

All the following tests were made with an aqueous solution of 1 part of the alkaloid to 100 water.

Mercuric chloride, in the aqueous solution of the alkaloid, throws down a white cheesy precipitate, insoluble in an excess of the precipitant, easily soluble in hydrochloric acid; on heating to boiling the precipitate softens, but does not actually melt; it is difficultly soluble in boiling water; on cooling it is re-deposited in an amorphous state.

A few drops of *mercuric chloride* give a white precipitate in a solution of the hydrochloride, which disappears on shaking, but when the mercuric chloride is in excess, a white crystalline precipitate is thrown down, which is rather easily soluble in hot water; on cooling, crystals in the form of rhombic prisms and plates are deposited, soluble in hydrochloric acid.

Copper sulphate in an aqueous solution of the alkaloid gives a light green precipitate, insoluble in an excess of the alkaloid. In a solution of the hydrochloride the copper sulphate does not produce any change.

A few drops of *gold chloride* added to the aqueous solution give a reddish-white precipitate, which disappears on shaking; a larger quantity of the reagent gives a flocculent reddish-white precipitate, which is persistent, soluble in hydrochloric acid with difficulty.

In the solution of the hydrochloride a few drops of gold chloride give a reddish-white precipitate, which re-dissolves on agitation; a larger quantity of the reagent gives a

---

* A Paper read before the Royal Society of New South Wales November 3, 1880.

reddish precipitate, which is permanent but easily soluble in hydrochloric acid, much more so than the precipitate from the alkaloid.

Tannic acid gives a greyish-white precipitate in the aqueous solution—easily soluble in hydrochloric acid. In the neutral solution of the hydrochloride there is a greyish-white turbidity only, which disappears on the addition of hydrochloric acid.

The double iodide of mercury and potassium ($HgI_2,2KI$) gives a heavy white crystalline precipitate in the aqueous solution. Under the microscope this is seen to be made up of small plates arranged in stellate groups. With hydrochloric acid the precipitate becomes yellow and pasty, but does not dissolve in the cold, readily soluble on heating; on cooling the solution becomes turbid.

In the solution of the hydrochloride $HgI_2,2KI$ gives a heavy amorphous yellowish white precipitate; on the addition of a little hydrochloric acid it becomes pasty; on heating a part dissolves; with a larger quantity of hydrochloric acid, the whole dissolves on heating; on cooling it is re-deposited as a yellow amorphous powder.

On the addition of a small quantity of an alcoholic solution of iodine a yellowish turbidity only is imparted to the solution, which is persistent for some hours; but a greater quantity produces a brown precipitate.

On treating the alkaloid with concentrated sulphuric acid and a trace of potassium bichromate in powder, the fluid takes the colour of the bichromate; after a time it changes to a dirty brown and then to green. When warm the change of colour takes place immediately.

With manganese peroxide (MnO_2) instead of the bichromate, no change takes place in the cold; when warm a faint violet colour is produced.

The alkaloid behaves very like nicotine with picric, phospho-molybdic, and metatungstic acids; the addition of picric acid throws down a yellow precipitate soluble in hydrochloric acid.

Phospho-molybdic acid forms a yellowish white amorphous precipitate, insoluble in cold dilute hydrochloric acid, easily and completely dissolved on warming.

The precipitate with nicotine is a dirty yellowish white amorphous, insoluble in cold dilute hydrochloric acid, soluble when warmed, but apparently not so readily as is the precipitate from the piturie alkaloid, some white flakes being left undissolved.

Metatungstate of sodium forms with both piturine and nicotine a white amorphous precipitate, soluble only in much dilute hydrochloric acid when warmed.

Iodine.—When iodine dissolved in ether is added to an etherial solution of the alkaloid the fluid becomes brownish-red and turbid; after a short time yellowish red needles are deposited, the mother-liquor being yellow: these crystals are easily soluble in alcohol, yielding a brownish-red solution; when the alcoholic solution is evaporated at the ordinary temperature, indistinct needles and oily drops are left behind.

When this alcoholic solution is treated with caustic soda in the cold, a smell similar to that of iodoform is emitted, not that of the alkaloid; from the nicotine compound nicotine is liberated, according to Wertheim (Watts's "Dictionary of Chemistry," iv., p. 47).

The iodine compound of piturine melts at about 110° C., that of nicotine at 100° C. (Watts's "Dictionary of Chemistry," iv., p. 47).

Differences.

From coneine it is distinguished by its aqueous solution not becoming turbid on heating nor by the addition of chlorine water. It differs from aniline by not being coloured by chloride of lime; it differs from picoline in specific gravity (picoline being only 0·9613 at 0° C.); from pyridine by its reaction with copper sulphate, the precipitate $Cu(OH)_2$ produced by pyridine with copper sulphate re-dissolves in an excess of the precipitant; and it appears to be distinguished from nicotine by its reactions with platinic chloride, gold chloride, iodine and mercuric chloride also by Palm's test. According to Palm (*Russische Zeitschrift für Pharmacie*, i., 4, and *Husemann's Pflanzenstoffe*), nicotine when gently warmed with a little hydrochloric acid of 1·12 specific gravity turns violet, and on the addition of a little strong nitric acid the colour changes to a deep orange—the only sample of nicotine to be obtained in Sydney yielded the latter part of the above test very well; the orange being very stable, the violet colour was not so well marked. The piturine does not change colour at all, but when more heat is applied it becomes yellow.

The Composition of the Alkaloid.

To determine the composition of the alkaloid, the carbon and hydrogen were estimated in the usual way by combustion with lead chromate, the nitrogen by the soda-lime process; the ammonium chloride left after the evaporation of the excess of hydrochloric acid was titrated with decinormal solution of silver nitrate.

The alkaloid for the determination of the carbon, hydrogen, and nitrogen was taken from two different specimens prepared from two different supplies of the piturie, but in both cases the boiling-points were the same, viz., 243° to 244° C.

To prevent oxidation, the alkaloid was enclosed in the combustion bulbs immediately after its preparation.

The results obtained were as follows:—

	I.	II.	III.	IV.	V.	VI.	VII.	VIII.
Carbon	76·63	76·64	—	—	lost	76·53	—	76·46
Hydrogen	8·49	8·46	—	—	8·52	8·51	—	8·41
Nitrogen	—	—	14·80	15·00	—	—	15·01	—

The average of these eight analyses is—

Carbon	76·56
Hydrogen	8·48
Nitrogen	14·94

And the relative proportions when calculated n the usual way are—

Carbon	5·98
Hydrogen	7·96
Nitrogen	1·00

or very nearly 6 : 8 : 1.

The formula would therefore be C_6H_8N, which requires—

	Theory.	Found.
$C_6 = 72 =$	76·59 per cent	76·56 per cent.
$H_8 = 8 =$	8·51 ,,	8·48 ,,
$N = 14 =$	14·90 ,,	14·94 ,,
94	100·00	99·98

To confirm this formula a platinum double salt was prepared in the usual manner. The crystals so obtained were orange red octahedra fairly soluble in warm water, but very easily soluble when even a trace of the free alkaloid is present; partly soluble in alcohol, but insoluble in ether.

To ensure as far as possible uniformity of composition, the platinum salts were always prepared from the same portion of alkaloid with the same solution of platinic chloride, and as much as possible under the same circumstances; notwithstanding this the percentages of platinum and of chlorine obtained were never the same, for the salts prepared at different times, neither did they fit in or correspond with the above-mentioned formula. The amount of chlorine was too small for the usual proportion of 1 Pt to 6 Cl met with in the normal double salts of platinum; in some cases it was even less than 1 : 5.

The amount of platinum was determined in twenty-three cases upon salts prepared at ten different times, but from the same substance and with the same platinic chloride; the amount of Pt varied from 34·15 per cent to 38·40 per cent; seven analyses yielded between 35·35 and 35·55 per cent Pt. Nine determinations of chlorine were made, and they varied from 31·32 to 36·86 per cent Cl.

The platinum salt is therefore clearly not of uniform composition or else very unstable; it undergoes decomposition with loss of chlorine during evaporation, even when conducted under the desiccator without the aid of heat.

The mercuric-chloride double salt, prepared by adding an excess of saturated solution of mercuric-chloride to a solution of the hydrochloride of the alkaloid, crystallised well in rhombic plates and prisms; the double salt was crystallised from boiling water, dried at 100° C., and the amount of mercury and chlorine determined in it.

Two analyses gave—

	I.	II.	Mean.
Mercury ..	63·26 per cent	63·09 =	63·175
Chlorine ..	24·60 ,,	24·64 =	24·620

The mean results calculated in the usual manner come to 1·00 Hg : 2·1955 Cl, or 5 Hg : 10·9775 Cl, or very nearly 5 Hg : 11 Cl, which would fit to the formula—

$$(C_6H_8N)_2HCl+5HgC_2,$$

which requires 63·31 per cent Hg and 24·72 per cent Cl, while the corresponding compound of nicotine,

$$C_{10}H_{14}N_2,HCl+5HgCl_2,$$

would require 64·37 per cent Hg and 25·15 per cent Cl.

Besides, nicotine is said to form under the same circumstances a double salt containing 4 $HgCl_2$ instead of 5 molecules of $HgCl_2$. (*Vide* Watts's "Dictionary of Chemistry," iv., 47.

The above two analyses appear to make it probable that the true formula of the alkaloid is $(C_6H_8N)_2$ or $C_{12}H_{16}N_2$, *i.e.*, double that yielded by its ultimate analysis, but much importance cannot of course be attached to such a compound as $(C_6H_8N)_2HCl+5HgCl_2$, in which the amount of alkaloid present is so very small.

Alkalimetric Power.

0·2986 grm. of the alkaloid required 18·5 c.c. 1-10th normal sulphuric acid, a corresponding amount to that required by nicotine, to form $(C_{10}H_{14}N_2)_2H_2SO_4$; the molecular weight of nicotine being 162, $0·0162\times18·5=0·2997$ instead of 0·2986.

I hope at some future period to continue the subject of this paper; meanwhile my best thanks and acknowledgments are due to my assistant, Dr. Helms, now Assistant Demonstrator in the University Laboratory, for his very valuable help in carrying out the details of this investigation.

Note. The name of this substance has been spelt in many different ways, such as, "pitchiry," "picherie," "pedgery," "bedgery," and "pitury"; the most usual spelling at present is "pituri." To show that the final "i" in pituri is not to be pronounced as "i" in *pine* I have spelt the word "piturie."

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, March 17th, 1881.

Prof. H. E. Roscoe, President, in the Chair.

The minutes of the previous meeting were read and confirmed. The following certificates were read for the first time:—A. J. Anderson, B. Browning, T. R. Ord, G. C. Robinson, W. R. Smith During the evening the following gentlemen were ballotted for, and declared duly elected Fellows of the Society (the Scrutators were Dr. Japp and Mr. J. Spiller):—W. E. Adeney, H. Borras, J. F. Braga, T. C. Day, R. A. Edgell, E. I. G. Gill, M. Hiddingh, O. B. Mills, O. V. Piscari, L. F. O'Shea, F. Tiemann, G. Valentine, A. Walker.

The following papers were read:—

"*On the Volume of Mixed Liquids*," by F. D. Brown. The author was led to make the experiments recorded in his paper by the necessity of ascertaining with perfect certainty and tolerable facility the composition of any given mixture of two liquids. This necessity arose in some other researches in which the author was engaged. He determined to make use of density as the most readily accessible property. On mixing several liquids in pairs he found that in most cases a considerable expansion took place, in a few cases a contraction, whilst in only one case did the volume remain unaltered. Similar facts had been observed by MM. Bussy and Buignet. The author proceeded to measure these changes of volumes with great exactness. Special precautions were taken regarding the temperature, the volume, and the weight of the liquid. A carefully prepared thermometer was very carefully used. The tubes used for containing the liquid were of the form suggested by Dr. Sprengel. The mixtures first tried were carbon disulphide and benzene, carbon disulphide and carbon tetrachloride, carbon tetrachloride and benzene. Curves and tables are given representing the difference between the observed and calculated volumes. These liquids had no apparent action on each other; the first two pairs expanded considerably, the third slightly contracted. The author thought that perhaps liquids having the same boiling-point might mix without change of volume: this hypothesis was found to be false in the case of dichlor-ethane, boiling-point 84°, and benzene, boiling-point 80°. Similarly the idea that substances whose molecular volumes were the same would mix without change of volume was proved to be untrue in the case of dibrom-ethane, molecular volume 88·6, and benzine, molecular volume 86 6, which substances expand when mixed. Finally, the author was led to the conclusion that these changes of volume are dependent on the chemical character of the molecules, and are entirely independent of such physical properties as the vapour tension, molecular volume, &c., similar curves being obtained with mixtures of carbon tetrachloride and benzene and carbon tetrachloride and toluene. All the above experiments were made at 20° C. From the experiments of Mendeljeff, and Dupré and Page, it would seem that the change of volume would be less marked at higher temperatures.

Prof. McLeod asked if in every case, whether expansion or contraction took place, heat was evolved on mixing.

Dr. Debus asked whether, at the point of maximum expansion of a mixture, the proportion of liquids in that mixture indicated a simple molecular relation, and whether expansion was always accompanied by absorption and contraction by liberation of heat.

Mr. Brown said that it was very difficult to say, as the curve was nearly horizontal, where the point of maximum expansion really occurred, but in the case of alcohol and water the greatest contraction seemed to take place when 1 molecule of alcohol was mixed with 3 molecules of water. Expansion was not always accompanied by absorption of heat.

The next paper was read by Mr. R. Cowper, "*On the Action of Alcohol on Mercuric Nitrate.*" With the intention of preparing some fulminate of mercury, the author had dissolved some mercury in nitric acid, and from accidental circumstances had left the solution standing some days before adding alcohol. On the addition of this substance, and heating, a precipitate formed which was not fulminate of mercury. The investigation of this body is given in the present paper. Its formation was first observed by Soluro and Selmi, and afterwards investigated by Gerhardt, who describes it as a nitrate of ethyl, the hydrogen of which is entirely replaced by mercury, crystallised with a molecule of mercuric nitrate and 2 molecules of water, $C_4Hg_5(NO_3)_2Hg(NO_3)_22H_2O$: this substance was not re-crystallised, and was probably impure. Mercury is dissolved in twelve times its weight of nitric acid(1·3): the solution is allowed to stand until all nitrous fumes have escaped, and the liquid is colourless; 12 parts by weight of pure alcohol, sp. gr. 0·80, are added, and the mixture heated. As soon as a precipitate forms the source of heat is withdrawn. The crystalline precipitate is washed with alcohol, and then with water. It was re-crystallised from dilute nitric acid (1 vol. in 4), and gave on analysis the formula $(C_2H_2Hg_3O_2)''(NO_3)_2$. It detonates when mixed with sand, and struck. If its temperature be raised rapidly, it explodes at 129° to 130°. If the temperature be raised very slowly it decomposes quietly, leaving oxide and nitrate of mercury. This substance can be prepared without heat. Treated with fuming nitric acid and alcohol it yields fulminate. It may be regarded as the nitrate of a dyad-radical, consisting of acetylene combined with mercury and mercuric oxide. By treatment with potash a hydrate was obtained $(C_2H_2Hg_3O_2)(HO)_2$. By treatment with potassic oxalate, an oxalate was obtained from the nitrate with the formula $(C_2H_2Hg_3O_2)C_2O_4$. Sulphuretted hydrogen decomposes the nitrate, forming mercaptan and mercury sulphide. In a note appended to the paper Dr. Debus looks upon this new base as belonging to the type glycol, $C_2H_4(HO)_2$, new base $(C_2H_2Hg_3O_2)(HO)_2$.

Dr. DEBUS referred to the interesting nature of the paper just read. This substance was interesting in two ways: first, because it was a step towards fulminate of mercury from alcohol and mercury nitrate, and, secondly, because of its constitution. He was at first inclined to view the substance as a compound of acetylene, C_2H_2, with ortho-nitrate of mercury, $C_2H_2.Hg_3(NO_4)_2$, but it was evident from its behaviour that we had really to do with an organic base containing mercury. In answer to a question of Dr. Armstrong he stated that free nitric acid was in all probability always present, as well as mercury nitrate.

"*On Boron Hydride*," by F. JONES and R. L. TAYLOR. The authors found that magnesium boride could not be formed by acting on borofluoride of magnesium with potassium. They give three methods for the preparation of this substance. The first consists in acting on boric anhydride with magnesium. Boric anhydride, which has been recently and thoroughly ignited, is mixed with twice its weight of magnesium dust, placed in a crucible the lid of which is firmly wired down, and heated in an ordinary fire. The reaction is violent; as soon as it is completed the crucible is removed from the fire, and allowed to cool. The residue in the crucible is chiefly a grey friable mass containing boride, nitride, and oxide of magnesium, also boron and magnesium. The second method consists in heating amorphous boron to a dull red-heat with magnesium dust in a current of hydrogen. In the third method the vapour of boron trichloride is passed over heated magnesium dust in an atmosphere of hydrogen. The first method is the most convenient for obtaining the magnesium boride in quantity. The boron hydride is obtained by heating magnesium boride with hydrochloric acid, but has not been obtained in a pure state, being always mixed with a large excess of hydrogen. The gas is colourless, with a most disagreeable odour, exciting nausea and headache, and is but little soluble in water. It burns with a green flame, which gives a brown stain on porcelain. It is decomposed by heat with separation of boron, and gives a black precipitate with silver nitrate, containing silver and boron. It combines with ammonia, yielding a compound which is decomposed by acids. The composition of the hydride, as far as could be ascertained by combustion of the mixture of hydride and hydrogen with copper oxide, is represented by the formula BH_3.

"*On the Action of Aldehyds on Phenanthraquinon in presence of Ammonia*," by Dr. F. R. JAPP and Mr. E. WILCOCK. In a previous paper the authors described the preparation of a benzenyl-amido-phenanthrol by the action of benzaldehyd containing hydrocyanic acid on phenanthraquinon. This same compound can be obtained with greater facility by heating phenanthraquinon, benzaldehyd and aqueous ammonia at 100° in an open flask on a water-bath. The substance when purified crystallises in tufts of colourless silky needles, fusing at 202°. Similar compounds have been prepared and studied by substituting cumin-aldehyd or furfur-aldehyd for benzaldehyd. Acetaldehyd has no action on phenanthraquinon in presence of ammonia. If, however, phenanthraquinon was heated with aldehyd ammonia a product was obtained which could not be purified, and so its investigation was abandoned. By the action of salicyl-aldehyd on phenanthraquinon a new compound, $C_{21}H_{14}N_2O$, was obtained, a further investigation of which is promised.

"*On the Action of Benzoic Acid on Naphthaquinon*," by Dr. JAPP and Mr. N. H. J. MILLER. When naphthaquinon is heated with benzoic acid to about 160°, the liquefied mass almost solidifies from the separation of minute crystalline needles. Water is eliminated during the reaction. The product is purified by boiling first with alcohol to remove the excess of benzoic acid, then with aniline, and finally with alcohol again. The new compound is thus obtained in microscopic ramiform needles, fusing above the range of the mercurial thermometer, and insoluble in all solvents yet tried. Analysis gave results indicating the formula C_9H_4O. Its formation may be expressed thus:—

$$\underbrace{2C_{10}H_6O_2}_{\text{Naphthaquinon.}} + \underbrace{C_7H_6O_2}_{\text{Benzoic Acid.}} = C_{27}H_{12}O_3+3H_2O.$$

This compound is exceedingly stable. By oxidation with potassium permanganate in aqueous solution, phthalic, but no benzoic, acid is obtained. The authors find that naphthaquinon also reacts with various other acids, both monobasic and dibasic, yielding crystallised compounds which are still under examination.

In answer to Dr. ARMSTRONG, who criticised the nomenclature employed in the first part, and thought it was misleading,

Dr. JAPP stated that he had only followed the precedent of Ladenburg, who first prepared bodies of this class.

"*Note on the Appearance of Nitrous Acid during the Evaporation of Water*," by R. WARINGTON. Schönbein stated some time ago that whenever pure water, or an alkaline solution, is evaporated, ammonium nitrite is produced, and that the same salt is formed during ordinary combustion in the air. It has been, however, since shown by Wright, Carius, &c., that this occurrence of nitrites is due to impurities, in the materials used or in the atmosphere, in which the experiments were conducted. The fact, however, still remains that pure water evaporated to a small bulk under the ordinary conditions will generally contain nitrous acid. The author has endeavoured to determine the conditions under which this occurs. He finds that pure water, when evaporated over a gas or even a spirit flame, always contains nitrites (1 litre of water in four hours contained 0·05 m.grm. of N); but that by using steam this quantity is diminished to one-twelfth, and by evaporating the water in a retort the introduction of nitrites could be altogether avoided. He proves also that distilled water, when exposed to the ordinary atmosphere of a room in an evaporating-dish, absorbs in a few hours sufficient nitrous acid to be detected. Less nitrous acid is obtained when the water is exposed in the country. Thus after twenty-seven days' exposure in fields, water contained nitrous acid equal to 1 part of nitrogen in 15 millions of water. In conclusion the author gave some account of the marvellously delicate test proposed by Griess, which far surpasses the delicate meta-phenylendiamine test. The latter can detect only 1 part of nitrogen as nitrous acid in 10 millions of water: the former gives a distinct reaction with 1 part in 1000 millions. The test is described in *Deut. Chem. Ges. Ber.*, 1879, 427. The solution to be tested is acidified with hydrochloric acid, a few drops of sulphanilic acid and a few drops of an aqueous solution of hydrochlorate of naphthylamin added: if nitrous acid is present a rose colour is developed; in strong solutions a dark red precipitate falls. The author expresses his obligation to Dr. Witt for calling his attention to the test and furnishing him with the necessary materials. The author exhibited the delicacy of this test, and the absorption of nitrous acid from the atmosphere of the meeting-room, by a dish of water which had been exposed since six in the evening. The water immediately turned rose-red on the addition of the solutions.

Dr. Gilbert said that Mr. Warington had proved that the evaporation of water did not cause the oxidation of nitrogen, but that the nitrous acid which was found in water which had been evaporated was derived from combined nitrogen existing in the fuel or in the air. It was not, however, so clearly proved that the nitrous acid in the atmosphere was not produced by the oxidation of nitrogen.

Mr. J. Spiller had used the meta-phenylen-diamin test, and had reached the same limit of delicacy as that mentioned by Mr. Warington, 1 in 10 millions.

Dr. Wright then read a paper by Mr. Rennie and himself, "*On the Sweet Principle of* Smilax glycophylla." The leaves of this plant have long been used in Australia as a remedy for scurvy, &c., but no investigation of the sweet principle seems to have been hitherto made. The aqueous extract of the leaves was first treated with alcohol, to precipitate albuminous bodies, filtered, and the alcohol distilled off after filtration; the residue was then shaken up with ether two or three times. The ethereal extract on evaporation yielded a yellowish crystalline mass, readily soluble in boiling water. This substance on purification yielded a body, $C_{13}H_{14}O_6+2$ or $3H_2O$. Its molecular weight could not be determined. On fusion with potash at 250°, acidifying, &c., an acid, $C_9H_{10}O_3$, melting-point 127° to 128°, was obtained giving no colour reaction with ferric chloride, and an odour of a phenol when heated with soda lime. As the original substance extracted from the Smilax seems to have properties distinct from the active principle of ordinary sarsaparilla and from glycyrrhizin, the author suggests provisionally the name glycyphyllin.

"*Note on Usnic Acid and some Products of its Decomposition*," by the late J. Stenhouse and C. E. Groves. Pure usnic acid can be prepared from the crude acid, extracted from *Usnea barbata* by treatment with lime and water by first converting it into an insoluble basic compound (*Chem. Soc. Journ.*, 1880). This compound is then washed, decomposed by boiling with dilute hydrochloric acid, and the precipitate collected and washed. The precipitate is stirred up with a considerable excess of soda and hydrogen sodium carbonate added in excess; nearly pure sodium usnate is thus precipitated. This is purified by re-solution and re-precipitation. The pure sodium usnate is then dissolved in hot spirit containing soda, and acetic or hydrochloric acid added: pure usnic acid is thus thrown down in a crystalline state. If pure sodium usnate be boiled with dilute hydrogen sodium carbonate for some hours, air being excluded, a yellow solution is obtained, turning black on exposure to the air. When 1 part of usnic acid is dissolved in 3 parts by weight of strong H_2SO_4, the solution heated for three hours to 60°, and then cooled and poured into 15 parts of a water, a flocculent precipitate of usnolic acid, $C_{27}H_{24}O_{10}$, is formed. This substance after purification crystallises from hot spirit in small yellowish prisms, insoluble in benzene, carbon disulphide, and ether; readily soluble in dilute alkalies. From the formation of this substance, the authors suggest the formula $C_{54}H_{50}O_{21}$ for usnic acid, which also agrees well with the analytical numbers. The molecular weight of usnolic acid could not be fixed.

The next three papers were taken as read.

"*On the Absorption of Solar Rays by Atmospheric Ozone, and on the Blue Tint of the Atmosphere*," Part II., by W. N. Hartley. The author has adopted for the estimation of ozone the process in use at the Observatory of Montsouris. The ozone is absorbed in a solution of arsenious acid to which a little neutral potassium iodide has been added. The excess of arsenious acid is estimated with standard iodine solution. The following are the author's conclusions:—1. Ozone is a constituent of the higher atmosphere to a much larger extent than near the earth's surface. 2. Ozone is destroyed by contact with gases and organic matter in a moist atmosphere, as near the earth's surface, and that the collection of ozone from the air is attended by the destruction of it to a large extent. 3. The absorptive power of the ozone in the air is quite sufficient to account for the limitation of the solar spectrum. 4. The blue tint of the atmosphere is largely due to ozone.

"*On the Nature of Certain Volatile Products contained in Crude Coal-tar Benzenes*," by Watson Smith. The author has examined a sample of benzene from a London tar from the so-called "first runnings" of the still. After some weeks of continued fractional distillation the author split up the product with three main portions:—(1) boiling 40° to 53°; (2) 81° to 82°; (3) above 82°. No. 1 contained carbon disulphide equal to about 6 per cent of the original crude benzene, and by treatment with bromine furnished bibromamylene. No. 2 was pure benzene. The author looked carefully for alcohol and aceto-nitrile, but was unable to detect more than remote traces of either. It is stated by Vincent and Delachanal, and by Witt, that alcohol occurs in benzene distilled from coal-tar; but as the products with which they were worked were rectified, *i.e.*, treated with 3 per cent of strong H_2SO_4, followed by agitation with alkaline lyes and subsequent distillation, the author considers that the vinic alcohol might have been formed during this rectification.

"*Contributions from the Laboratory of the Royal College of Chemistry* (*On New Zealand Kawii Gum*)," by E. H. Rennie. This resin, the produce of the coniferous tree *Dammara Australis*, was first examined by Mr. R. D. Thomson, who obtained by distillation an amber-coloured oil to which he gave the name Dammarol. Mr. M. P. Muir also studied this substance, and by distillation obtained an oil boiling at 155° to 156°, to which he gave the formula $C_{10}H_{20}O_7$. The author has re-examined the subject. He heated the gum in a copper vessel through which a rapid current of steam was passing: 15 lbs. of the resin yielded 750 c.c. of oil. By re-distillation a large portion was obtained boiling at 157° to 158°, colourless, with a strong odour of turpentine. On analysis it gave numbers indicating $C_{10}H_{16}$. It had a very slight action on polarised light. By the action of phosphorus pentasulphide, &c., some cymene was obtained. On oxidation it yielded terephthalic and acetic acids. It therefore appears that the oil produced by the distillation of Kauri gum consists almost entirely of a terpene resembling the other members of the family.

The Society then adjourned. The Anniversary Meeting will take place on March 30th, when the Longstaff Medal will be presented to Dr. Thorpe. The next ordinary meeting is on April 7th, when a paper will be read "On the Estimation of Hydric Peroxide by Means of Potassic Permanganate," by W. E. Adeney.

CORRESPONDENCE.

SMOKE AND FOG.

To the Editor of the Chemical News.

Sir,—I have perused your review of the work of Mr. F. Edwards (which I have not yet read), on London smoke, fog, &c., in which he refers to a proposition of mine, made by me nearly twenty-five years ago, for getting rid of the smoke of large towns. Mr. Edwards dismisses my scheme because of its engineering difficulties, and no doubt there are such, though not I think fatal ones; but the only one of these he specifies shows that he did not consider my scheme of so much importance as to induce him to make any calculation as the basis of his condemnation.

I proposed a chimney for Manchester 600 feet high and 100 feet internal diameter; this would give a circular area of 7500 feet (and I should build my chimney circular), but Mr. Edwards says that for London it would require a diameter of 720 feet; this would give a circular area of 385,800 feet, over fifty times what is required for Manchester. Now Manchester by next census will be found to have a population of considerably over 600,000, or at least one-seventh of that of London. As I allowed an exit for ten times the quantity of air during the working day, required to consume all the coal used in Manchester, I think the same ratio ought to be ample for London. A chimney 300 feet diameter gives a circular area of 67,000, or nearly ten times what Manchester requires. Probably, if Mr. Edwards would go into the other engineering difficulties they might also become in appearance less formidable, and at least surmountable. That sufficient ascensive power can be got by this means to carry all the London smoke so high as to convey it by diffusion and otherwise out of the habitable region is unquestionable, while the increasing annoyance growing in power year and year will at last, I have little doubt, culminate in such a catastrophe as I pointed out as a possibility. That, given an atmosphere, still, and with little tendency to diffusion under the influence of a dense fog, with all the produced carbonic acid accumulating, it might reach the point of 7 per cent of that gas, which would render it as instantly destructive of life as the Grotto del Cane, or the workings of a coal-pit after an explosion of carburetted hydrogen gas.

This is a serious matter for Londoners, and though not yet a probable event is certainly possible, and will become more highly probable as time goes on.

But, Mr. Editor, why not combine my scheme with one still greater, and which when united would enable the living to live longer and much more comfortably, and when dead—as die they must—provide for them a quiet and secure resting-place near to the scene of their life's labours? Let 100 acres of land be laid out in a circular area of about 2040 feet diameter, in a convenient locality. In the centre of this build my chimney, 300 feet diameter, with walls 20 feet thick at the base, and with arches at regular intervals to receive the underground ventilating drains. These arches must radiate out all round for 850 feet. When filled up level the top of these arches would form a circular plain on which to build catacombs, somewhat similar to those of ancient Palmyra, the plain having a slight incline, so that one generation working round would cover up its predecessor, and form a basis for the succeeding generation. Thus, like a new Tower of Babel, would the vast mound grow up, till it reached the top of my chimney, which might be 1000 feet high. An inclined roadway would wind up on the outside of the catacomb area, gradually, of course, narrowing the space; but by beginning with an area of 3000 feet instead of 2000 feet, it would still be a large space, probably a century hence, with "ample room and verge enough" for many other generations to be gathered to their fathers: this, however, would require another 100 acres of land to commence with. All this catacomb space would have ventilating shafts communicating directly with the great chimney, preventing the slightest smell or taint from the whole structure. The monumental records could all be placed on the surface, but would be covered up by the succeeding range of structure; but some means might be found of ensuring a little longer immortality.

My scheme, Mr. Editor, has claims upon the dead as well as upon the living; but if the latter would only lay it to heart I have no fear of the former objecting to so comfortable and stable a domicile in which to sleep through the ages, awaiting the trumpet's call.

If something is not done by the living, then the fog, like the sword of Damocles, will continue to hang over the denisens of London. Anthracite coal, or half carbonised bituminous coal, is only a fallacious cure, as the resulting gases are not thereby diminished or made in the least degree less deleterious. Get them raised a a thousand feet into the atmosphere, and the law of diffusion will do the rest for you; but you must have my chimney or else some better scheme.—I am, &c.,

Peter Spence.

Erlington House, Manchester,
March 21, 1881.

DEOXIDATION OF NITRATES.

To the Editor of the Chemical News.

Sir,—As chemists are at present much interested in nitrates, I may mention the following from a paper written some months ago: I cannot be sure of the time when it may be published:—

"A peculiar putrefactive condition produces a deoxidation of nitrates. In some conditions nitrogen is eliminated as gas, the oxygen going to the carbon in whole or in part. In weak solutions containing water enough to absorb the carbonic acid (probably), nearly pure nitrogen may be obtained with considerable rapidity."

I mentioned this as probable in my paper on "Organic Matter in Water," 1868; the words may be quoted:—"After putrefaction has occurred in the Medlock, at Manchester, I have not found it" (nitric acid). "The oxygen seems to be removed as the oxygen of the air is, probably leaving nitrogen to pass off as gas."—I am, &c.,

R. Angus Smith.

March 21, 1881.

A SCOLDING!

To the Editor of the Chemical News.

Sir,—The notice of my paper (Chemical News, vol. xliii. p. 42), under "Proceedings of Societies," is a puzzle. The paper, it is stated, was taken as read. If so, if something has been read substantiating the notice, it is not my paper that has been read; and if my paper has been read the notice is a misrepresentation. The substance of the paper is the setting forth of a fact; the relative weight of undoubtedly single molecules, for the first time in the history of chemistry, determined in an unobjectionable manner and independently of all theory or hypothesis, is communicated. Numerous facts illustrating and confirming the weights found are then quoted. The notice says the paper "consists of a lengthy theoretical disquisition, in which the author maintains the following propositions:—That the combining weights of all elements are one-third of their present values," &c. The difference between the disclosing and substantiation of a fact and a theoretical disquisition is so great that the idea of a misunderstanding is excluded, and the notice presents itself as a deliberate, studied misrepresentation, with regard to which I beg leave to state that I cannot indorse a resort to fraud in scientific circles of high repute, seemingly for no other purpose than to elude the consideration of unwelcome scientific facts.—I am, &c.,

E. Vogel.

San Francisco, February 28, 1881.

[Our report of the meeting of the Chemical Society on January 20th was official. An author who says that "the cause of chemical action is undoubtedly atmospheric pressure" can scarcely complain if his paper is called "theoretical."—*Ed.* C.N.]

AN EXAMINATION QUESTION.

To the Editor of the Chemical News.

Sir,—It may interest your readers, and tempt them to exert their ingenuity, to copy a question lately given at an Oxford examination for a Studentship in Natural Science. The question is "In what relation do single substances stand to other objects, and elements to other single substances?" This question does honour to the examiner, both by its ingenuity as well as by the clear and lucid language in which it is couched.—I am, &c.,

F. I. C.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, l'Académie des Sciences. No. 9, February 28, 1881.

Action of Hydracids upon Halogenous Salts containing the same Element.—M. Berthelot.—Compounds formed by the union of a hydracid and a haloid salt containing the same element, exist as well in the case of alkaline salts, where they are marked out by the absorption of the gas, by the liberation of chlorine and by special reactions, as in case of the metallic salts, properly so-called where they are obtained in crystals. In both cases they are partially dissociated. Such compounds, far from being exceptional, represent a very widely distributed order of bodies. Among the monobasic acids, acid acetates and formiates have long been known. M. Ditte has recently called attention to the acid nitrates, and in a narrower range of analogies, we may recall the hydrofluorates of the alkaline fluorides. The hydrochlorates of the chlorides and the hydrobromates of the bromides are compounds of the same class distinguished merely by a less degree of stability.

Disinfecting and Antiseptic Action of the Vapour of Nitrous Ether.—M. Peyrusson.—This ether has proved successful as a disinfectant both in laboratory experiments and in medical practice.

Radiophony.—E. Mercadier.—The author has constructed instruments which may be called thermophonic batteries or phonic thermomultipliers.

Application of the Fringes of Talbot for the Determination of the Indices of Refraction of Liquids.—M. Hurion.—A mathematical paper, not capable of useful abstraction.

Displacement of the Soda of Sodium Chloride by Copper Hydrate.—D. Tommasi.—Copper hydrate in a moist state possesses the singular property of liberating a certain quantity of alkali, if it is brought in contact with certain saline solutions, such as sodium and potassium chloride, potassium bromide, sodium sulphate, &c. The displacement of the alkali takes place even at temperatures as low as 4° and 5°. If copper hydrate, well washed, and moist, is added to a solution of sodium chloride at 10 per cent, the liquid in a few minutes acquires an alkaline reaction, which increases on standing. Meantime the hydrate is converted into a pale green powder, containing chlorine. Moist copper carbonate acts in a similar manner.

Combustion-Heats of Certain Alcohols of the Allylic Series and of their Isomeric Aldehyds.—W. Louguinine.—The author has determined the combustion-heats of allyl-dimethyl-carbinol, allyl-dipropyl-carbinol, menthol, diallyl-methyl-carbinol, and valeric aldehyd. The difference between the combustion-heats of œnanthol and valeric aldehyd is 320,439 cals.

Products of the Splitting-up of Proteic Substances.—A. Bleunard.—The author has prepared in a state of purity the compound $C_4H_7NO_3$, which is obtained along with gelatine-sugar, when bromine is allowed to act upon gluco-proteine in presence of water.

Synthetic Homologue of Pelletierine.—A. Etard.—The hydrogen contained in ammonium hydrochlorate acts as a reducing agent upon glycerin, eliminating its hydroxyls in the state of water. The result of the reaction is an oxygenous alkaloid, C_6H_9NO, isomeric with one of the hydroxy-picolines, which the theory of the pyridic series enables us to foresee.

A Cause of Deterioration in Cloth.—M. Balland.—Goods dyed rust, buff, or chamois shades with salts of iron occasionally undergo a slow combustion. The ferric oxide is alternately reduced by the organic matter of the tissue and re-oxidised by the oxygen of the air.

Reimann's Färber Zeitung,
No. 40, 1880.

This number contains nothing of general interest.

No. 41, 1880.

At a Berlin feather-dyeing establishment an ostrich feather dyed in shades with methyl-violet was laid upon a paper upon which some ammonia had been poured but had dried up again. After a time the feather became partially green, the green passing gradually into violet, and producing an extraordinary effect. This reaction is being utilised in feather-dyeing, and will probably be applied in the manufacture of artificial flowers.

The colours prepared by Meister, Lucius, and Brüning, and by the Berlin "Actien Gesellschaft für Anilinfabrikation," and sold as Ponceau, are formed by associating disulpho-naphtholic acid with cumidine.

MISCELLANEOUS.

College of Agriculture.—At a meeting of the Council of the Wilts and Hants Agricultural College, at Downton, Salisbury, on Wednesday, it was unanimously resolved that the College should be henceforth called the College of Agriculture.

Truth is Stranger than Fiction.—Our contemporary *Truth*, discoursing on nitroglycerine, instructs its readers as follows:—"The explosive character arises from this: nitrogen is composed of molecules in pairs of atoms. Nitric acid contains only one atom in its molecules. Upon this atom being set free from its unstable combination in the glycerine, the two atoms of nitrogen rush together, producing a vast amount of energy of combination in the shape of heat. The gaseous products are thus heated, and an explosion takes place immediately."

NOTES AND QUERIES.

*** Our Notes and Queries column was opened for the purpose of giving and obtaining information likely to be of use to our readers generally. We cannot undertake to let this column be the means of transmitting merely private information, or such trade notices as should legitimately come in the advertising columns.

Annual production of Alum, &c.—Can anyone give the annual United Kingdon production each of alum, alum cake, and sulphate of alumina, and the average price for the last five years?—Alum.

Patent Dryers.—Will some correspondent kindly inform me what should be the composition of the so-called "patent dryers" used by painters; whether barium sulphate and calcium carbonate are adulterants, and, if not, for what purpose they are added? I should also like to know if lime is ever a constituent of these dryers.—L. A.

MEETINGS FOR THE WEEK.

Monday, 28th.—Medical, 8.30.
—— Society of Arts, 8. "The Scientific Principles Involved in Electric Lighting," Professor W. G. Adams, F.R.S.
—— Royal Geographical, 8.30.
Tuesday, 29th.—Royal Institution, 3 p.m. "The Blood," Prof. Schäfer.
—— Civil Engineers, 8.
Wednesday, 30th.—Society of Arts, 8. "Recent Advances in Electric Lighting," W. H. Preece, M.Inst.C.E.
—— Chemical. Anniversary, 8.
Thursday, 31st.—Royal, 4.30.
—— Royal Institution, 3. "Ornament," Mr. H. H. Statham.
Friday, April 1st.—Royal Institution, 8. "The King, in his Relation to Early Civil Justice," Sir H. S. Maine, 9.
—— Geologists' Association, 8.
Saturday, 2nd.—Royal Institution, 3. "American Humourists," Rev. H. R. Haweis.

THE CHEMICAL NEWS.

VOL. XLIII. No. 1114.

ON THE
BASES PRODUCED BY THE DISTILLATION OF CINCHONINE WITH POTASH.

By C. GREVILLE WILLIAMS, F.R.S.

IN the CHEMICAL NEWS, vol. xliii., p. 130, in noticing the chemical papers in the *Comptes Rendus* for February 21, the paper of M. Oechsner de Coninck on "Pyridic Bases," is called "A further account of the three bases which the author discovered in the products of the distillation of cinchonine with potassa." The three bases alluded to are lutidine, collidine, and parvoline. The author appears, as regards the first two bases, only to have seen a short notice of my first memoir, which appeared in the *Ann. Chim. Phys.*, xlv., p. 488. As regards parvoline, I discovered it in 1854 (*Quart. Journ. Chem. Soc.*, July, 1854). Chemists are aware that I regard the lutidine obtained from cinchonine as isomeric and not identical with the base of the same composition from bone-oil. In my "Researches on Isomeric Alkaloids" (*Proc. Roy. Soc.*, June, 1864), I have given the results of a laborious comparison between the lutidine of Anderson and the lutidine from cinchonine, and the results clearly showed their isomerism; I therefore provisionally gave the latter base the name of β-lutidine. M. Oechsner de Coninck's first paper (*Bull. Soc. Chim. Paris*, Sept., 1880) contains such a number of analyses, densities, vapour-densities, &c., which have *all* been done by me before, that it is evident he has not consulted my original papers. In an article on β-lutidine, which I hope soon to have the honour of bringing before the Royal Society, I shall enter into the question at greater length.

ON THE
ACTION OF SODIUM UPON CHINOLINE.*

By C. GREVILLE WILLIAMS, F.R.S.

IN 1867 I made some experiments on the action of sodium upon chinoline and lepidine, and found that a substance was produced which dyed silk a beautiful but fugitive orange colour. I announced this fact in a paper "On the Higher Homologues of Chinoline."† I made analyses of the products at the time, but the difficulties in the way of preparing them pure were so great, and the time at my disposal was so limited, that I did not make public any quantitative results until March, 1878, when I published a short note "On the Action of Sodium on Chinoline and Lepidine."‡ In that paper I gave the results of an analysis of a product from chinoline, which agreed with the formula $C_{18}H_{14}N_2.HCl$, which is obviously that of the hydrochlorate of dichinoline. I also gave an analysis of the nitrate of dilepidine, which agrees almost perfectly with the theoretical values; but I did not enter into the details of the modes of preparation. In the course of my investigation of β-lutidine, it was natural that I should study the action of sodium upon it, but I met with so many and unexpected difficulties that I determined to prepare myself for a new attack upon the subject by a fresh investigation of the action of sodium upon chinoline. As I find that other observers are working upon chinoline, β-lutidine, and β-collidine,* I have thought it desirable to bring before the Society the results obtained, although the investigation is still proceeding.

Action of Sodium upon Chinoline.

The action of sodium on chinoline is exceedingly remarkable, not merely because it polymerises the base, for a similar result, as is well known, takes with picoline, but because the products have properties which are, I think, different from any yet observed among organic substances. For a yellow oil like dichinoline to yield a true although fugitive dye, in the form of a brilliantly red crystalline hydrochlorate, is probably a unique reaction. To obtain this product of the utmost beauty, it appears to be necessary that the chinoline should be perfectly free from any impurity, except, perhaps, its next homologue. The most successful preparations were made from chinoline obtained from fine crystals of the chromate.†

Chinoline prepared from the chromate is almost colourless, and becomes yellow, on keeping, with extreme slowness as compared with the base prepared without that precaution. In the following experiments it is to be understood that all the chinoline was prepared from the crystallised chromate.

Chinoline was boiled with sodium, the fluid, which became purplish crimson, was treated with water, which at once converted the crimson colour into a dirty yellow. Hydrochloric acid was then added, and the solution became of an intense orange colour. The solution was boiled, filtered, and allowed to stand two days, the crystals of hydrochlorate of dichinoline were filtered off, and the mother-liquid was precipitated fractionally by solution of platinic chloride. The first precipitate was of a light orange colour, the second a deep orange, the third Naples yellow, the fourth was in the form of a brown crystalline powder. The platinum was determined in each with the following results:—

No. of Precipitate.	Percentage of Platinum.
I...	22·59
II...	23·83
III...	28·30
IV...	28·59

The first result agrees with the numbers required for the formula—

$$2(C_{18}H_{14}N_2)HCl.PtCl_4,$$

which requires 22·18 per cent of platinum. The second is probably a mixture of the substance having the formula of the first precipitate with some of that having the formula of the third, which latter agrees fairly with a salt having the formula—

$$C_{18}H_{14}N_2.3HCl.PtCl_4,$$

which requires 28·00 per cent of platinum. The formula—

$$C_{18}H_{14}N_2.2HCl.PtCl_4,$$

requires 29·51 per cent. There are other formulæ which agree with the numbers obtained, but they do not appear to me so readily admissible. For instance, a substance having the formula—

$$2(C_{18}H_{14}N_2)PtCl_4,$$

would require 23·13 per cent of platinum, which would agree with the amount of metal obtained from the second precipitate, but the formation of such a substance in the presence of free hydrochloric appears most unlikely. Nevertheless, it is remarkable that the platinum salt obtained from the products of the action of sodium on chinoline and β-lutidine, often agree in their percentages of

---

[*] A Paper read before the Royal Society, March 17, 1881.

[†] *Laboratory*, May, 1867, p. 109.

[‡] CHEMICAL NEWS, vol. xxxvii., p. 85.

[*] *Bull. Soc. Chim.*, [2], xxxii., 486 to 489; Boutlerow and Wischnegradsky, *loc. cit.*, No. 9, June 5, 1880; Oechsner de Coninck, *Bull. Soc. Chim.*, Nos. 4 and 5, p. 210, September 5, 1880. The latter chemist has repeated several of my older experiments, evidently under the impression that they had not been made before.

[†] It is much to be desired that those chemists who believe in the identity of chinoline and leucoline, and who possess the latter in a pure state, would study the action of sodium upon it; as, if it yields the crystalline scarlet hydrochlorate, the question might be considered as settled.

platinum with substances having formulæ of the polymerised bases united directly to platinic chloride.

Action of Sodium Amalgam on Chinoline.

25 grms. of chinoline and 20 grms. of sodium amalgam containing 10 per cent of sodium were mixed. The action commenced in the cold, and red streaks appeared where the base and the amalgam were in contact. When the action ceased in the cold, the mixture was warmed on the water-bath; the reaction started again immediately, and the whole became of a deep red colour. No gas was given off. The next day the mixture had assumed the consistence of thick treacle; when heated on the water-bath it softened, but the amalgam remained hard; the fluid had turned from purplish red to yellow, but reddish streaks were still formed on stirring, showing that the reaction was not complete. At this stage 5 grms. more amalgam were added. After four or five hours of constant stirring on the water-bath the red streaks ceased to appear, and the whole became a greenish yellow oil, the greater portion of which was poured off, and the residue containing much undecomposed amalgam was treated with hot water. The amalgam decomposed with violence, and when the action was over excess of hydrochloric acid was added, and the solution was boiled and filtered. Three liquors were taken off and kept separate from each other; each solution gave on cooling crystals of the hydrochlorate of dichinoline; they were in the form of needles of so brilliant a scarlet that, on comparison with a sample of the finest vermillion, the latter looked brown by contrast with them. The first solution yielded 1·1 grms. of air-dried product, the second 0·4, and the third 0·25, in all 1·75 grms. from 25 grms. of chinoline. The scarlet crystals bleach on exposure to light and become pale brown on drying in the water-oven, and the brown colour itself rapidly bleaches on exposure to light.

The mother-liquors of the scarlet crystals on evaporation to a quarter of their original bulk, deposited a pale yellow precipitate too small for analysis; it was nearly insoluble in cold water.

The mother-liquors affording no further crystals on evaporation were treated with excess of potash to enable the chinoline to be recovered; 11 grms. were obtained, being 44 per cent on the chinoline taken; deducting the recovered chinoline from that originally employed, the produce of the scarlet crystals become 12·5 per cent on the base originally taken.

Action of Sodium Amalgam on the Recovered Chinoline.

The recovered chinoline was dried by sticks of potash for a short time, and then rectified to see if its boiling-point had undergone any alteration by the treatment with sodium amalgam; however, it came over at almost exactly the same point as it did before. It is very remarkable that in spite of the fact last mentioned, the product of the action of the amalgam upon the recovered base was of a totally different character to that of the same reagent upon the original chinoline.

The 11 grms. of recovered chinoline were treated with 20 grms. of amalgam, effervescence took place, and much heat was developed; this was possibly caused by traces of moisture remaining in the base. When the effervescence was over, 5 grms. more amalgam were added, being in all 30 grms. for 11 of base, whereas in the first experiment equal parts of base and amalgam were used; this fact has to be remembered in considering the causes of the different result. The red colouration took place as before; it is, however, a very ephemeral reaction, the colour on a glass rod soon disappears, and does so immediately on spreading the substance in a thin layer on the side of the beaker in which the operation is conducted. The experiment was made precisely as with the original chinoline, and the reaction appeared to proceed exactly in the same manner as before; but, on boiling out with dilute hydrochloric acid, the product of hydrochlorate of dichinoline was much smaller, and the crystals were too small to be distinguished as such by the naked eye.

The mother-liquors were treated with potash, as before, to enable the chinoline to be recovered, when to my surprise a *solid yellow base* was obtained, which on boiling some time with water to expel any adhering chinoline, became, on cooling, a hard resinous mass; on drying in the air it weighed 7 grms., or 63 per cent on the 11 grms. of recovered chinoline used.

In order to gain some insight into the nature of the new solid base, it was converted into a hydrochlorate and fractionally precipitated with platinic chloride. 1 grm. was dissolved in 50 c.c. of hot diluted hydrochloric acid; on cooling a part separated out; this could have been prevented by a great excess of hydrochloric acic, but on this occasion the separation was permitted as a mode of purification. The precipitate was filtered off, and some hydrochloric acid was added to prevent the water in the solution of platinic chloride from causing a further precipitation. On adding the platinum solution, a dense bright yellow precipitate was formed; to the filtrate more platinum solution was added, and so on until four precipitates were obtained. The second, third, and fourth were buff coloured, but the last on standing became of a dirty buff colour. The last two were in too small quantity for analysis.

The first precipitate gave 18·47 per cent of platinum. Assuming for the present that the yellow solid base from the recovered chinoline is isomeric with that which yields the scarlet hydrochlorate, it may be mentioned that a salt having the formula $2(C_{18}H_{14}N_2)4HCl.PtCl_4$, would require 19·76 per cent of platinum. The second precipitate gave 23·49 per cent of platinum, and yielded, therefore, almost the same percentage of the metal as the second precipitate obtained from the product of the action of sodium upon the original chinoline, and the remarks made upon that precipitate apply equally to the present one.

Experiments were subsequently made to ascertain if, in presence of excess of hydrochloric acid, platinum salts of a different constitution would be formed. For this purpose 1 grm. of the new solid base was treated with 10 c.c. of *strong* hydrochloric acid, it dissolved with effervescence as if carbonic anhydride had been absorbed; the solution took place with moderate readiness; it was filtered and treated with solution of platinum as before, a buff-coloured precipitate was obtained. At this point 10 c.c. more hydrochloric acid were added, the precipitate became smaller; 25 c.c. more hydrochloric acid were added at this stage, and the solution was heated to about 90° and filtered. Much of the platinum salt remained on the filter, and after drying gave 23·92 per cent of platinum; the mother-liquid on cooling gave another precipitate containing 24·55 per cent of platinum. Both these precipitates appear, therefore, in spite of the great excess of acid in which they were formed, to be constituted like the second precipitates previously obtained.

The solid yellow base contained 3·06 per cent of ash, which consists of carbonate of lime with a trace of iron, both derived from the chemicals used in its preparation.

The solid base when heated fuses to a yellow oil, giving off precisely the same odour as chinoline compounds generally; near a red heat it boils away, leaving some carbon, which, contrary to the usual rule in such cases, burns away readily.

Nitric acid dissolves the base easily, giving a reddish brown solution, which, on dilution with water, affords a yellow precipitate; ammonia turns the solution red, and partially dissolves the precipitate.

Preparation of the Platinum Salt from the Scarlet Hydrochlorate of Dichinoline.

The scarlet hydrochlorate of dichinoline was dissolved in boiling water, and precipitated while boiling by an excess of platinic chloride. The high temperature of the solution was necessary to prevent the precipitation of the hydrochlorate with the platinum salt. The latter was o a beautiful pale cadmium yellow colour. The filtrate on cooling yielded fine needles in extremely small quantity. The precipitate contained 24·54 per cent of platinum, and probably, therefore, had the same composition as those before mentioned, containing the same or nearly the same amount of platinum. The needles contained 35·7 per cent of platinum, and it is most likely that the presence of a small quantity of this salt was the cause of the high platinum in the first precipitate. A direct combination of dichinoline with platinic chloride, $C_{18}H_{14}N_2.PtCl_4$, would require 33·11 per cent of platinum, but it is not easy, as I have said before, to admit such a formula, when it is remembered that the precipitation took place in the presence of hydrochloric acid.

A salt of the formula $2(C_{18}H_{14}N_2)HCl.2PtCl_4$, would require 33·66 per cent of platinum, and would only differ from the salt $2(C_{18}H_{14}N_2)HCl.PtCl_4$, before alluded to, and which contains 22·18 per cent of platinum, by containing one more equivalent of platinic chloride. It must, however, be distinctly stated that the numbers in this paper are given provisionally, and that the subject is still under study.

THE ESTIMATION OF PHOSPHORUS IN STEEL

By J. OLIVER ARNOLD, F.C.S.

THE accurate determination of phosphorus in steel is perhaps the most important problem with which the steel chemist has to deal, and there is a great diversity of opinion as to which is the best method to use for its estimation.

In the majority of the iron and steel laboratories the method known as the "molybdate" is used; in some few that known as the "magnesia" method. Some chemists, and prominently Mr. Riley, state that results obtained by the molybdate process are generally lower than results obtained by the magnesia method; others maintain that the two methods agree. When commencing the experiments enumerated below, I had a mental impression that the two processes would practically agree.

For the purposes of the experiments, a large quantity (about 500 grms.) of ordinary Bessemer steel was selected, drilled, and carefully bottled. Six quantities, varying from 4 to 6 grms., were taken, and the phosphorus was carefully estimated by the molybdate process, which is briefly as follows:—

The steel is dissolved in warm 1·20 HNO_3, evaporated to dryness, and strongly heated; the dried oxide is taken up with HCl, silica, &c., is filtered off, and the solution is evaporated to the lowest possible bulk, a few c.c. of HNO_3 added, and then a moderate excess of a nitric acid solution of ammonic molybdate. The yellow phospho-molybdate is allowed an hour or two at a temperature of about 70° C. to precipitate; it is filtered off, washed with HNO_3 water, dried at 100° C., and is brushed from the filter paper, and weighed. The results were:—

	Per cent Phosphorus.
A	0·0605
B	0·0680
C	0·0638
D	0·0713
E	0·0593
F	0·0627
Mean	0·0643

Six more determinations on similar quantities were now made by the magnesia method. The steel was dissolved, and dried down as before, taken up in HCl, transferred to a flask, and diluted to 750 c.c. with a dilute solution of Na_2SO_3. After reduction the solution was boiled, nearly neutralised with AmHo, ammonium acetate and a few drops of Fe_2Cl_6 added, and the solution again boiled. The resulting precipitate was dissolved in HCl, and evaporated to a bulk of about 10 c.c. After the addition of 10 c.c. of a strong solution of citric acid, the solution was made strongly alkaline with ammonia, and finally mixed with 2 c.c. of magnesia mixture. After standing thirty-six hours with occasional stirring, the precipitate of $AmMgPO_4$ was filtered off, washed with AmHo water, and was dried, ignited, and weighed as $Mg_2P_2O_7$. Results:—

	Per cent Phosphorus.
A	0·0755
B	0·0762
C	0·0737
D	0·0766
E	0·0778
F	0·0800
Mean	0·0766

The magnesia thus gave a mean of 0·0123 per cen higher than the molybdate; the slight loss resulting in brushing out the molybdate precipitate will not account for this large discrepancy. In every case, on boiling the filtrate from the phospho-molybdate, a further precipitate was obtained, mixed, however, with MoO_3. It should be noted that in the case of the molybdate, the hygroscopic nature of the precipitate would tend to make the result higher than the truth. Three estimations were now made on 5 grms. of the steel after adding the following quantities of $Mg_2P_2O_7$. The pure salt was taken and ignited, and the weighings made when cool.

	Grms.		P.c. Phosphorus.		P.c. Phosphorus.
A	0·0077	=	0·0431	gave	0·1158
B	0·0122	=	0·0682	,,	0·1348
C	0·0139	=	0·0777	,,	0·1488

Subtracting from the total result the average of the steel results, by magnesia, the results are:—

	Theory p.c.		Found p.c.		P.c. low.
A	0·0431	–	0·0392	=	0·0039
B	0·0682	–	0·0582	=	0·0100
C	0·0777	–	0·0722	=	0·0055

Mean low .. 0·0065 per cent.

This indicated the magnesia method to be slightly low.

A similar trial was now made with the molybdate method. Added pure $Mg_2P_2O_7$.

	Grm.		P.c. Phosphorus.		P.c. Phosphorus.
A	0·0150	=	0·0839	gave	0·1129
B	0·0090	=	0·0503	,,	0·0928

Subtracting the average by molybdate we get:—

	Theory p.c.		Found p.c.		P.c. low.
A	0·0839	–	0·0486	=	0·0353
B	0·0503	–	0·0285	=	0·0218

Mean low .. 0·0285 per cent.

This result shows the molybdate method to be seriously low. This is to be attributed to the fact that the presence of so large an amount of Fe_2Cl_6, and of the free HCl which it is impossible to get rid of by evaporation, retains a portion of the phosphoric acid in solution.

The next experiment was made on 5 grms. of the steel, to see if by boiling the solution and bringing down free MoO_3 the whole of the H_3PO_4 could be precipitated. The precipitates were washed with HNO_3 water, dissolved in AmHo, and re-precipitated with magnesia. Results:—

	P.c. Phosphorus.
A	0·0654
B	0·0690

The result still being low an attempt was made as follows:—

The viscid solution was neutralised with AmHo and the iron precipitated taken up in 1·40 HNO_3, molybdate added, and the solution boiled, the precipitate being treated as in the preceding experiment. Results:—

	P.c. Phosphorus.
A	0·0721
B	0·0692

These last results, though slightly higher, show that it is impossible to precipitate the whole of the phosphoric acid in the presence of the total amount of iron. Mr. Riley, in a paper on the estimation of phosphorus in steel, read before the Chemical Society in March, 1878, proposed the following modification of the molybdate method:—"The method I propose is to dissolve the steel or iron in 1·20 nitric acid, avoiding as much excess as possible; to the solution, diluted to rather more than half a pint, sodium sulphite is added, so as to reduce the iron to FeO after boiling off the sulphite (a large excess should be avoided); the phosphorus is precipitated with some peroxide as basic acetate and phosphate, precisely as in the magnesia method; the precipitate is dissolved in hydrochloric acid, the solution made alkaline with ammonia, and the precipitate formed is dissolved in 1·40 nitric acid. The solution is then precipitated with molybdate of ammonia in the ordinary way." He also gives the result of an unsuccessful experiment by the process.

Two experiments made by this method on 5 grms. of the standard steel, gave—

	P.c. Phosphorus.
A	0·0722
B	0·0720

This shows an improvement, but the result is still lower than the magnesia result.

Proceeding on the principle of the above method, but evaporating the HCl solution of the phosphate and basic acetate of iron to a very low bulk (about 5 c.c.), the solution was neutralised with AmHo, and the precipitate obtained taken up in 1·40 HNO_3. By this treatment all free HCl is got rid of, and a nitric acid solution of the phosphate obtained, which is precipitated with the molybdate reagent and boiled, a considerable amount of free MoO_3 coming down in addition to the phosphorus salt. This precipitate was thoroughly washed with HNO_3 water till free from any trace of Fe, re-dissolved in AmHo, and a portion of the latter neutralised with HCl to form AmCl, and finally 2 c.c. of magnesia mixture added; the total bulk of the solution should be about 40 c.c. Five estimations on 5 grms. each gave—

	P.c. Phosphorus.
*A	0·0775
*B	0·0810
*C	0·0789
D	0·0857
E	0·0855
Mean	0·0817

* These estimations were precipitated in a bulk of 100 c.c.

This result is higher than the magnesia mean by 0·0051 per cent.

To see how the results by this method agree with theory, 0·0113 grm. $Mg_2P_2O_7$ was added to 5 grms. of the steel; this weight of magnesia salt being equivalent to 0·0632 per cent P. Result—

0·1460 per cent phosphorus.

This − 0·0817 per cent, the average in the steel by this method, gives—

Theory p.c.	Found p.c.
0·0632	0·0643

This would indicate the method to be very accurate, more so than the ordinary magnesia. In an analysis of axle steel my colleague, Mr. King, kindly made an estimation by both methods, which gave—

	P.c. Phosphorus.
A—Magnesia method	0·0681*
B—Modified method..	0·0794

* Allowed 30 hours to precipitate.

Thus bearing out my results. The length of the magnesia method is also a very serious drawback; the molybdate, though rapid, is not reliable, as the results are nearly always low. The proposed modification of the two methods takes a rather longer time than the molybdate to carry out, but is much shorter than the magnesia, as the double phosphorus salt is completely precipitated in four to six hours, whereas the magnesia requires thirty-six hours, and it would seem that even after that time the presence of the double citrate of iron and ammonium retains a small amount of phosphate in solution.

Summary.

1. That the phosphorus contained in a steel cannot be totally precipitated in the presence of the total amount of iron by ammonic molybdate.

2. That even if the greater portion of the iron is removed as in the magnesia process, and is treated as described above, the whole of the H_3PO_4 cannot be precipitated at a temperature low enough to obtain the definite salt of molybdic acid.

3. That if the solution be boiled the whole of the phosphoric acid comes down with varying quantities of free MoO_3, and that on dissolving this precipitate (after thoroughly washing with nitric acid water) in AmHo, and forming AmCl by neutralising a portion of the ammonia with HCl; the whole of the H_3PO_4 may be obtained on addition of a magnesia salt as $AmMgPO_4$.

4. That the magnesia method is slightly low, probably owing to the slight solubility of $AmMgPO_4$ in the double citrate.

An experiment was made to see what the influence of unwashed filters would be on a phosphorus determination, as in the course of the analysis at least two filters are treated with HCl. Ten best Swedish filters 120 m.m. in diameter gave—

$Mg_2P_2O_7$ .. .. 0·0043 grm.

In an estimation on 5 grms. of steel this would give an error of 0·0048 per cent high; it is therefore advisable to wash all filters used in phosphorus determinations.

I have no hesitation in adding that many of the hurried estimations of phosphorus, carried out by the molybdate process in the laboratories of iron and steel works, are utterly unreliable.

Sheffield, March 17, 1881.

ON THE

ELIMINATION OF CARBON DISULPHIDE FROM COMMERCIAL BENZOL.

By BENJAMIN NICKELS.

The paper of H. Macagno, appearing in the Chemical News, vol. xliii., p. 138, on the "Analysis of Carbon Disulphide by Potassium Hydrate in Absolute Alcohol," is of much practical interest, and as it represents a rapid and expeditious method of eliminating that product from commercial benzol and one on which I have been much engaged during the past six months, I am induced to ask your permission for publication of results that may probably become of much interest to those interested. Considerable attention has already been given to this subject in Germany, and methods have been published both by Luck and Dr. Hoffman, but in their detail they are far too troublesome and costly to find favour or adoption as technical tests. On the other hand, the alcoholic potash method is so simple and rapid in its operation that it may be conducted without increase of ordinary apparatus or extra manipulative skill.

It is well known that a trifling quantity of carbon disulphide, to the extent of 1 or 2 per cent only, constitutes a serious disturbing cause in the ordinary method of benzol testing, causing it to boil low, and with abnormal percentages over at the "85 point," so much so that a really good sample containing it may be suspected and even discredited. The method that I have followed for its removal, and in which the benzol is placed in its true character, is as follows:—

I usually take about 200 c.c. of the sample under examination, and if of 90 per cent quality, add to it 20 c.c. (10 per cent) of a saturated hot solution of potassium hydrate in absolute alcohol, methylated or otherwise. The mixture is then subjected to frequent agitation during a space of two hours; the potash compound of carbon disulphide rapidly forms and subsides in feathery groups with a silky and glistening appearance. At the expiration of the time named, I filter off the benzol so treated and subject it to two washings with its own bulk of water in a suitable separator; this operation completely removes the alcohol from the benzol. Finally, I run off the wash-water, remove the benzol, and shake it up with a little powdered gypsum (plaster-of-Paris), by which means the suspended and dissolved water is instantly removed, and the benzol left clear and anhydrous.

Presuming the sample operated upon to have been a "light 90 per cent," the difference noticeable will be considerable. First, entire disappearance of previous alliaceous odour; secondly, decrease of gravity from 0·885 to 0·882 or 0·880, varying with quantity of bisulphide originally present and removed; thirdly, disappearance of abnormal boiling-points, falling from 30 per cent or more at the "85 point" to 10 or 12 per cent only. The entire operation may be conducted in the space of two and a half hours, and offers an adjunct to benzol testing, which I think will sooner or later find its recognition. Benzol so treated will be found to boil much closer and to enable a far nearer judgment as to its true composition. Should further verification be required, recourse may be had to method of specific gravity, which with bisulphide absent affords reliable indications. The hydrocarbons associated in commercial benzol are homologous, and as such suffer little alteration from condensation or expansion volume under admixture, and sp. gr. found is pretty nearly the mean of the mixtures.

In following up these results I have compared them with a vast number of mixtures from pure materials of known gravity, and from which I have formulated a set of tables, enabling me to arrive at percentage of benzol, toluol, and xylol (together with carbon disulphide) present in a given sample with certainty. As a further confirmation, I have, through the kindness of Mr. John Browning in furnishing instruments, subjected these samples and admixtures to control, by measurement of refraction angles, and which has furnished results of so much interest that the method alone discriminates mixtures, and quantities hardly possible otherwise, and without resorting either to boiling or specific gravity.

As regards the alcoholic potash method I make no claim whatever to its originality; doubtless others have employed it, although, so far as I am aware, not in the precise way indicated.

In conclusion, I have sometimes thought that a modification of the process might be employed on the large scale for removing bisulphide from commercial benzol, and so cut out the tedious rectification resorted to for that purpose. Ordinary methylated alcohol in lieu of absolute for solution of potash answers nearly as well, but throws out the bisulphide compound in the form of a viscid brown fluid. From the resultant wash-water the surplus alcohol could be recovered by distillation, as in the case of processes resorted to in the manufacture of aniline dyes, and in which methylated alcohol is alternately used and recovered in very considerable quantity, and with little or no loss.

That this product cannot be removed within 1 to 3 per cent by ordinary factory rectification is well known, although as a matter of fact, with those employing the Continental separating or rectifying column (as now in use for the preparation of pure benzol and toluol), the operation becomes certain. The cost, however, of this plant is so heavy that it deters many from adopting it.

104, Leadenhall Street, E.C.

REMARKS ON THE TREATISE OF MR. C. T. KINGZETT:

"Report on the Atmospheric Oxidation of Phosphorus, and some Reactions of Ozone and Hydric Peroxide."*

By Dr. EM. SCHÖNE,
Professor of Chemistry at the Agricultur Academy in Petrowskoye, Rasumowskoye, near Moscow.

Some years ago Mr. Kingzett† disputed the fact that ozone is produced by the slow oxidation of phosphorus, In the latest paper which Mr. Kingzett has published under the title above mentioned, he owns that he was wrong. In the same paper he makes a few statements relative to the estimation of peroxide of hydrogen; these last induce me to make some remarks.

Mr. Kingzett recommends, for the quantitative determination of the peroxide of hydrogen in *dilute* solutions, the addition to the latter of a *very great* excess of *sulphuric* acid (from one vol. up to 5 vols. of acid diluted by 3 parts of water), then potassic iodide in crystals, and starch. After an interval of five minutes the iodine liberated is estimated by titration with the standard thiosulphate of sodium.

After describing several experiments relative to this process, Mr. Kingzett, among the conclusions drawn by him from these experiments, gives the following:—

"Pure neutral peroxide of hydrogen does not decompose potassium iodide with liberation of iodine, although it undergoes spontaneous decomposition."

As to the latter part of this statement, it is certain that peroxide of hydrogen undergoes decomposition, as I have already shown. In regard to the first part—the non-liberation of iodine—I confess that I was surprised when I read this statement, because the experiments pointed out by Mr. Kingzett prove the contrary. On page 804 he says:—

"Experiment 5.—Some of the peroxide solution . . . . was now *neutralised* with pure caustic soda, and to 20 c.c. of this solution was added KI and starch as usual; a trace only of *iodine was set free*, and bubbles of oxygen. . . ."

"Experiment 6.—5 c.c. of a 10-volume solution of hydric peroxide was diluted to 100 c.c., and the solution as nearly as possible *neutralised*. *Iodine was set free* on the addition of KI equal to only 1·8 c.c. N/10 thiosulphate solution, and the same time the solution *became alkaline* to test-paper and *evolved oxygen*." After this I do not understand why Mr. Kingzett enters into polemics with me; for his just-mentioned experiments *confirm* what I myself had found, namely, (1) the liberation of a *small* quantity of iodine; (2) the formation of a corresponding (therefore also a small) quantity of caustic potash; (3) the evolution of oxygen. It is true that in his fourth experiment Mr. Kingzett means that the liberation of iodine depends on the presence of free acid. However, in Experiments 5 and 6 the acid was neutralised, and the liberation of iodine still took place. If during the action of the *neutral* peroxide of hydrogen on a *neutral* potassium iodide caustic potash is formed—which Mr. Kingzett allows unconditionally—what becomes of the iodide of hydrogen corresponding to the produced potash. How can the formation of caustic potash be explained otherwise than by the decomposition of the quantity of hydrogen iodide necessary for its neutralisation, namely, according to the equation $2HI+H_2O_2=2H_2O+I_2$, with liberation of iodine? Mr. Kingzett says—"It occurred to me that, if this acidity were neutralised, peroxide of hydrogen would not liberate iodine from potassium iodide at all." But perhaps Mr. Kingzett had to do in such cases with very dilute solutions of peroxide, wherein the liberation of iodine, indeed, does not begin instantly, but after ten or fifteen minutes, increases slowly, and reaches its maximum only after the lapse of six hours

---

* *Journal of the Chemical Society*, 1880, i., p. 792.

† Chemical News, vol. xl., p. 96.

In a note on page 805 Mr. Kingzett says that it seems to him an inconsistency that I regard the decomposition of hydrogen peroxide in the presence of potassium iodide as a "catalytic" process, and at the same time allow the liberation of iodine. It is evident that Mr. Kingzett is not acquainted with my original treatise,[*] but has read only a very short and incomplete abstract of my paper, cited by him (*Jour. Chem. Soc.*, 36, 353). It is true that this gives a wrong idea of my interpretation of the facts. If Mr. Kingzett would give himself the trouble to read my original paper, he would find there the explanation of the seeming inconsistency. In reading it he would likewise understand how the reaction under consideration can be applied to a colorimetric quantitative determination of hydrogen peroxide in solutions which—as, for instance, atmospheric precipitates (rain, snow, &c.)—contain in 1 litre not more than 1 milligrm. of peroxide.

Concerning the above-mentioned method, proposed by Mr. Kingzett himself for the quantitative estimation of the peroxide of hydrogen, it must give very inexact results, especially if one has to do with very dilute solutions of peroxide, for this method has considerable sources of error.

First. It is well known that according to the greater or lesser concentration a greater or smaller quantity of sulphuric acid is decomposed by hydrogen iodide, according to the equation—

$$2HI + H_2SO_4 = H_2O + I_2 + H_2SO_3.$$

Bunsen has stated[†] that the amount of iodine and sulphurous acid, formed according to this equation, ceases to cause a perceptible error only when the dilution becomes so considerable that 10,000 parts of liquid contain less than 4 parts of sulphuric acid. And Mr. Kingzett operates with *very strongly* acidulated liquids, containing in 10,000 parts about 2000 parts of sulphuric acid—that is, 500 times more than is allowed!

Secondly. It is well known by the researches of V. Harcourt and Esson, that the amount of chemical change occurring at any moment is proportional to the amount of hydrogen iodide and hydrogen peroxide in the solution, the other conditions being the same. Therefore, in very diluted solutions of hydrogen peroxide the reaction is proceeding slowly, and cannot be finished in five minutes. It is true that Mr. Kingzett affirms that five minutes suffice when an abundance of sulphuric acid is added. However, he gives us no proof. On adding to 10 c.c. of a solution of peroxide of hydrogen from 30 to 50 c.c. of sulphuric acid, diluted by 3 parts of water, he found as much iodine (corresponding to 6·3 c.c. 1-10th normal solution $Na_2S_2O_3$) as was liberated "under the most favourable circumstances" (what is the meaning of that?); but this does not prove in the least that *all* the amount of peroxide contained in the solution just mentioned had undergone decomposition. To prove this by evidence is impossible, on account of other sources of error inherent to this method. But even had these sources of error not existed, the author should have at least determined precisely the peroxide of hydrogen in the trial solutions by a more trustworthy method; for instance, by titration with permanganate.

Lastly. Mr. Kingzett's method cannot be precise on account of the circumstance that iodide of hydrogen is decomposed by free oxygen, always to be found in the solutions of peroxide. What considerable errors can be caused by this circumstance, especially in determining the peroxide in very weak solutions; for example, in atmospheric precipitates. This I have already shown elsewhere.[‡]

In order to demonstrate the inexactness of Mr. Kingzett's method experimentally I will give the following experimental results. The solution of hydrogen peroxide used by me was quite neutral, and the potassium iodide was absolutely free of iodate.[*]

Experiment I.—A solution of hydrogen peroxide was precisely titrated by permanganate of potassium, and by diluting this a liquid was prepared, containing in 1 litre 1 milligrm. H_2O_2. To 100 c.c. of this liquid were added 400 c.c. of 1:3 sulphuric acid, then about 5 grms. KI in crystals, and 20 c.c. of starch. After five minutes the liberated iodine needed 2·0 c.c. of a solution of sodium hyposulphite, 1 c.c. of which was equal to 0·00605 grm. I, or 0·00081 grm. H_2O_2.

There was thus 0·00162 grm. H_2O_2 found, though in reality there was only 0·0001 grm. Therefore, in making use of Mr. Kingzett's method for the determination of the peroxide of hydrogen in atmospheric precipitates, which (in the neighbourhood of Moscow) only seldom contain more than 1 milligrm. H_2O_2 in 1 litre, *one would find at the least sixteen times more peroxide than is really contained in these precipitates.* This great error is principally the result of the mutual action of HI and H_2SO_4. By substituting for the sulphuric acid another acid not affecting HI—for instance, phosphoric acid—one might have removed *this* source of error, but the others remain. The action of free oxygen on HI especially hinders the precise estimation of peroxide, though in a less degree.

Experiment II. was executed in exactly the same way as Expt. I., with the only difference that for the sulphuric acid was substituted phosphoric acid of corresponding concentration. The liberated iodine needed here only 0·25 c.c. $Na_2S_2O_3$, equal to 0·0002 grm. H_2O_2.

Therefore, notwithstanding this substitution, twice as much H_2O_2 was found as was really taken, depending, as I have already mentioned, on the decomposition of HI by free oxygen contained in the solution.

March 5-17, 1881.

PHENOL OR CARBOLIC ACID: QUALITATIVE AND QUANTITATIVE TESTS.[†]

By E. WALLER, Ph.D.

It is almost unnecessary for me to mention the source from which the carbolic acid is obtained, or the mode in which it is prepared; a brief mention of these points, however, may not here be considered out of place.

The coal-tar contains substances which have been grouped as follows:

Bases.—Ammonia, methylamine, ethylamine, aniline, quinoline, picoline, pyrridine, toluidine, &c.

Acids.—Acetic, rosolic, and brunolic, &c., with what are really phenols, though they have been called acids, carbolic acid, or phenol, cresol, phlorol, thymol, &c.

Neutral Substances.—Benzene, toluene, cumene, cymene,—liquids; anthracene, chrysene, pyrene—solids.

In this country the method of obtaining commercial carbolic acid or crude phenol is usually as follows:—The portion called the "light oil" is distilled off at temperatures below 350° or 400° F. Steam is then passed through this light oil until no more of the oil can be carried off in this way. The mixed steam and vapour is condensed, the latter affording what is known as "refined coal-tar naphtha," and consisting of (benzol) benzene with some admixture of (toluol) toluene. What has not been volatilised by use of the steam is known as "naphtha tailings" and contains the most of the phenol in the original coal-tar. In England a somewhat different method is employed. A fraction coming off at lower temperature is first distilled off for the naphtha and the residue is treated for phenol. In either case the phenol is obtained by agitating the material with an aqueous solution of some fixed alkali, and after

---

[*] *Liebig's Annalen der Chemie*, 195, 228-252.

[†] *Annalen der Chemie und Pharmacie*, 86, 265.

[‡] *Zeitschrift für Analytische Chemie*, 18, 149.

[*] That was the same potassium iodide, the detailed examination of which has been described by me in *Liebig's Annalen*, 195, 234 and 235 in notes.

[†] Reprinted from the *School of Mines Quarterly*, for Jan., 1881.

separating the alkaline solution from the oil which does not dissolve, neutralising the alkali with an acid, which liberates the phenol.[*]

As carbolic acid or phenol is often called coal-tar creosote, and indeed resembles creosote in many respects[†] it is often necessary to distinguish between the two, or to detect any addition of the former to the latter.

The tests most relied upon for this purpose are—

1. The solubility of the sample in glycerine[‡] (Gr. 1·258.) Carbolic and cresylic acids (phenol and cresol) will dissolve, while creosote does not, at least unless less than half the sample consists of creasote.

2. The action with collodion. Creosote does not coagulate collodion (precipitate the nitro-cellulose) while phenol does.

3. The effects produced by addition of a few drops of ferric chloride to their aqueous solutions. Creosote gives a brownish yellow colouration, while phenol gives a bluish violet.[§]

Fluckiger[||] tests for the presence of phenol in creosote by warming a water solution of the sample with one-fourth its volume of ammonia hydrate, wetting the inside of a porcelain dish with this solution, and then blowing fumes of bromine upon the surface of the dish. In presence of phenol a fine blue colour appears. Creosote gives only a dirty green or brown. The test requires care to avoid excess of bromine, which spoils the reaction.

Still another test is that with a splinter of pine wood,[¶] which is first dipped in a water solution of the sample, and then in concentrated hydrochloric acid. In the course of half an hour the wood assumes a bluish colour if carbolic acid were present—at least such is the statement, but it has been found that concentrated hydrochloric acid alone will produce this effect, and the test has been abandoned as untrustworthy.

With regard to tests for phenol, independent of comparison with creosote, various tests have been proposed or used. The principal ones are as follows :—

Ammonia and Hypochlorite.[**]—On adding to a water solution of phenol about one-quarter its volume of ammonia hydrate, and then a solution of bleaching-powder or some hypochlorite, a fine bluish green colouration develops—rapidly, if heat is applied.[††] This is said to detect one part of phenol in 3000. The reaction has been used per contra as a test for ammonia, and for that purpose is tolerably delicate.

Nitric acid.[‡‡]—The addition of nitric acid to a solution containing phenol gives (especially on warming) a yellow colouration, due to the formation of picric (trinitrophenic) acid.

One part of phenol in 6000 may thus be detected but as nitric acid yields picric acid or other compounds having a yellow colour, with various organic substances, the test cannot be considered as very distinctive.

Mercury Nitrates.[§§]—Millon's reagent, &c. Solutions of mercury in nitric acid, affording mercurous or mercuric nitrates (one or both) containing some nitrous acid, have been proposed by different experimenters. Millon's reagent is a solution of mercury in fuming nitric acid. The addition of a solution of this kind to a water solution of phenol gives in a short time a strong blood red tint resembling the reaction of sulphocyanides with ferric salts. The reaction is hastened by the application of heat. The reaction is said to be perceptible when only one part of phenol in 200,000 is present.

Concentrated Sulphuric Acid.[*]—On pouring a solution containing phenol upon the surface of concentrated sulphuric acid in such a way that the liquids do not mix, the zone between them takes a greenish or bluish tint, becoming finally red. One part in 2000 is said to be perceptible by this test. The colours, however, are very delicate, and take some time to develop. Since different intensities of tint may be obtained with different qualities of sulphuric acid, the reaction may possibly be due to some impurities in the acid, perhaps nitrogen oxides.

Molybdic Acid in Concentrated Sulphuric Acid.[†]—The addition of conc. sulphuric acid containing ten per cent of molybdic acid in solution to a solution of phenol gives at first a bluish tint, which in a short time passes to reddish violet. The test is best performed in a white porcelain dish.

The reaction is said to serve for the detection of small amounts of phenol in creosote.

Potassic Dichromate with Concentrated Sulphuric Acid.[‡]—Pollacci highly recommends this test, which is performed in a similar manner to the last. The colouration produced is brown. The delicacy of the test is put at one part in 3000. The colouration is apparently due to the partial reduction of the chromic anhydride formed, and it might be anticipated that other organic compounds would give the same or a similar reaction. The test is but little used.[§]

Euchlorine Test.[||]—This is thus described :—

In a five inch test-tube put ten grains powdered potassium chlorate, pour on concentrated hydrochloric acid to the depth of one inch ; allow the evolution of gas to proceed for half a minute. Dilute with one and a half volumes of water and remove the gas by blowing through a bent tube. Pour in ammonia so as to form a layer on the top. Blow out the ammonium chloride fumes, and add a few drops of the sample, In the presence of phenol, the ammonia layer assumes a rose-red, blood-red, red-brown, or dark-brown tint, according to the amount of phenol present. One part in 12,000 gives the reaction.

Ferric Chloride.—The addition of ferric chloride to a solution containing phenol gives a fine bluish violet colouration. The reaction is materially interfered with by the presence of acids or neutral salts, and with water solution from crude samples it alters rapidly ; usually to a dirty greenish hue.

Bromine Water.[¶]—This test is readily applied. The addition of bromine water to a solution containing phenol gives a whitish curdy precipitate of tribromphenol, which re-dissolves in the solution of phenol when but little of the bromine water has been added ; a further addition renders the precipitate permanent. The delicacy of this test is one part in 43,700 (Landolt) one in 15,500 (Pollacci[**] and Locatell.) The precipitate is soluble in ether, alcohol, carbon disulphide, and the most of that class of solvents, as well as in alkaline solutions. The homologues of phenol, as well as aniline, toluidine, quinine, morphine, &c., give a similar precipitate. In contact with sodium amalgam the tribromphenol is re-converted into phenol, which may be recognised by its odour.

The cinchona alkaloids have also been proposed as tests for phenol.[††]

The odour of phenol is said to be perceptible to the extent of one part in 2800.[‡‡]

As quantitative tests for phenol the degree of solubility

---

[*] *Vide* "Commercial Organic Analysis." By A. H. Allen. Vol. i., note to p. 305.

[†] Creosote consists of a mixture of guaiacol, $C_7H_8O_2$, and creasol, $C_8H_{10}O_2$, while phenol is C_6H_6O. *Vide* Brauninger, *Jour. Lond. Chem. Soc.*, 1878, p. 2, 146.

[‡] T. Morson, *Jour. de Pharm. et de Chem.*, Dec., 1872.

[§] *Vide* Böttger, *Pharm. Centralhalle*, xvii., 284.

[||] *Arch. der Pharm.*, cciii., 30.

[¶] "U.S. Dispensatory," 13th ed., p. 342.

[**] R. Lex, *Berichte der Deutschen Chem. Gesell.*, iii., 457. Cotton, *Bull. Soc. Chim. de Paris*, xxi., No. 1. Salkowski, *Archiv. der Physiol*, v., 353.

[††] *Vide* Jacquemin, *Archiv. der Pharm.*, cciii., 47. Aniline with hypochlorite used.

[‡‡] Pollacci, *Gaz. Chim. Ital.*, iv., 8.

[§§] Plugge, *Fres. Zts. f. Anal. Chem.*, xi., 173. Fluckiger, *Archiv. der Pharm.*, cciii., 30. Poehl, *Pharm. Zts. f. Russland*, xvi., 547.

[*] Pollacci, *Gaz. Chim. Ital.*, iv., 8.

[†] Davey, *Polyt. Notizblatt.* 1878, 300. *Vide* Fröhde, *Zts. Allg. Oesterr. Apotheker-verein*, September 20, 1873.

[‡] *Ber. d. Chem. Gessell.*, vii., 360. *Gaz. Chim. Ital.*, iv., 8.

[§] Tasca Lanza, *Gaz. Chim. Ital.*, iv.

[||] C. Rice, *Am. Jour. Pharm.*, March, 1873, p. 98.

[¶] Landolt, *Ber. d. Chem. Ges.*, iv., 770.

[**] *Gaz. Chim. Ital.*, iv., 8.

[††] Hesse, *Liebig's Ann. Chem.*, clxxxi., Heft 1.

[‡‡] Landolt, *loc. cit.*

For comparison of the relative delicacy of these different tests see Landolt, *loc. cit.* Pollacci, *loc. cit.*, and Almen, *Archiv. der Pharm.*, vii., 44.

of a sample in water or in alkaline solutions,[*] and the ferric chloride[†] test have been used until quite recently. The two first methods consist of simply shaking up a measured amount of the sample with sufficient water or alkaline solution to dissolve it, were it all phenol, and measuring the amount of oil undissolved.

With pure water there exists the practical difficulty that the insoluble portion will partly rise to the top, partly sink to the bottom, and part again stick to the sides. Acting on Prof. Chandler's suggestion, I have used a measured quantity of olive oil with the sample, which will mix with the impurities, and in this way tolerably good results may be obtained. The oil, however, should not be added until the sample has been thoroughly shaken up with the water, since otherwise it will hold back some of the phenol, and prevent its solution in the water. Making the test with a solution of a fixed alkali presents fewer difficulties, but some of the impurities which are not phenol will also dissolve in the alkaline solution and give too high results. In either case the results are usually too high, since the crude phenol may hold a considerable quantity of water, which by this method is reckoned as phenol.

The ferric chloride test is a colorimetric test, and is performed by making a solution of the sample (10 grms. in 1 litre, for instance) filtering to clear it, and then comparing the colour obtained in 10 c.c. of this solution by the addition of two or three drops of ferric chloride, with the colour obtained in solutions of phenol of known strength, with the same amount of that reagent. The difficulty with the test is that solutions of the crude samples often afford a very different colour from that obtained with pure phenol, and moreover, in almost all cases the colour alters so rapidly as to give great difficulty in making a satisfactory estimation. Moreover, the test cannot be applied in testing carbolates of lime or similar preparations.

Taking the reaction described by Landolt (the precipitation of phenol by bromine) I have succeeded in obtaining what I believe to be a reliable method for the quantitative estimation of phenol. The results were obtained in 1873, and published the next year, not, however, in what I have heard called "the current of chemical literature," so that processes based upon this reaction have since been published[‡] which has given the authors the claim of priority in the matter. The method which I used is, however, somewhat simpler than the others.

The solutions necessary are:

1. A solution of 10 grms. pure crystallised phenol in 1 litre of water. This solution serves as the standard with which to compare the results obtained on the samples analysed. The solution will keep for some months without alteration.

2. Solution of bromine in water. In practice it has been found convenient to keep on hand two bottles, one with the bromine in the bottom, the other for the solution when it becomes sufficiently saturated.

3. Solution of alum in dilute sulphuric acid. Dilute sulphuric acid containing about 100 c.c. concentrated sulphuric acid in the litre is shaken with alum crystals until saturated.

The use of this solution is to aid in the ready separation of the bromine precipitate, by making it more dense, and by insuring the necessary acidity of the solution. The sulphuric acid also holds more alum in solution than pure water, which is an advantage. This solution is not absolutely indispensable, but in using it the analysis usually works more smoothly.

The process is conducted as follows:—10 grms. of the sample are weighed out and then run into a litre flask, water added, and the mixture shaken, the flask being finally filled up to the mark. After thorough mixing, some of the solution is filtered through a dry filter, and 10 c.c. of the clear solution is run into a six or eight oz. reagent bottle, fitted with tight fitting glass stopper, about 30 c.c. of the alum solution is added, and in a similar bottle 5 or 10 c.c. of the standard phenol solution are placed, also with about 30 c.c. of the alum solution. A burette is now filled with the solution of bromine, and from this the reagent is run into the bottle containing the standard solution of phenol until no more precipitate forms. The bottle must be stoppered and shaken after the addition of every few c.c. Toward the end of the reaction the precipitate forms rather slowly, and when the phenol has been saturated a very slight excess of bromine gives a yellow tint to the solution. Shaking the bottle causes the precipitate to separate readily, leaving the solution clear. The bromine water is usually taken of such a strength that about 30 c.c. are required to precipitate the phenol from 10 c.c. of the standard solution.

The solution from the sample is treated in the same way, and from the amount of bromine water required for each respectively the percentage in the sample may be readily calculated. *E.g.*, if 5 c.c. of the standard required 15 c.c. bromine water, and 10 c.c. of solution of the sample took 17 c.c., the calculation would be

$$(15 \times 2) : 17 = 100 : x \text{ per cent.}$$

If, in weighing out, 10·25 grms. instead of 10 grms. had been taken, this result would have to be divided by 1·025 to get the true percentage.

As the precipitate rises to the top instead of settling to the bottom, it will be found convenient to use a small glass tube, a little longer than the bottle and flared at the top in funnel form, through which the bromine may be introduced into the clear solution. The bromine water held in the tube by capillary attraction can be gently blown into the solution without inconvenience to the operator.

With most of the samples of commercial phenol "carbolic acid" the precipitate will not readily separate from the solution even by prolonged shaking. The solution may be at once cleared, however, by adding to it some of the precipitate already obtained by testing the standard phenol solution and shaking up.

The end reaction is when the further addition of bromine water fails to produce any precipitate. With pure phenol the solution only assumes a yellow colour when an excess of the bromine is present, but with many of the commercial samples the solution has a yellow tint from the start, which, however, does not appear to deepen until the phenol or its homologues are saturated. The effect of the bromine upon the homologues of phenol, as cresol, phlorol, &c., is probably the same, and in conducting an analysis by this method, those substances are reckoned as phenol. The absence of aniline, toluidine, and similar bases which may be present in the coal-tar should be insured, as those bases also react in a similar manner with the bromine water. Usually the mode of preparing the commercial carbolic acid by means of alkaline solutions precludes this source of error; with a dead oil, however, the sample requires a preliminary treatment with solution of some fixed alkali to remove them.

The bromine water does not of course keep the same standard throughout, but during a morning's work it varies very little. Until the solution gets low in the bottle, every other burette full seldom gives a variation greater than 0·1 to 0·2 c.c. on 10 c.c. of standard phenol solution. Unless the bromine water is allowed to stand in the burette for some time, the last portions have the same standard as the first.

The other quantitative methods using this reaction with bromine are somewhat more elaborate, an excess of bromine water being used, and the excess being titrated with sodium hyposulphite or detected by iodised starch paper. A stronger solution of bromine also is used, and the methods, though the same in principle, are quite different in detail.

---

[*] Ott, *Dingler's Polyt. Journ.* clxxxvi., 148. See also H. Muller' *Zts. f. Chem.*, N.F. i., pp. 271 *et seq.* H. Hager, *Pharm. Centralhalle*, No. 5, 1872.

[†] Leube, *Wittsteins Vierteljahresschrift f. Pharm.*, xx., 574. *Dingl. olyt. Jour.*, ccii.

[‡] Koppescharr, *Fres. Zts. f. Analyt. Chem*, xv., 233. Degener, *Journ. f. Prakt. Chem.*, N. F., xvii., 390.

NOTICES OF BOOKS.

Recueil des Travaux Chimiques du Dr. Domingos Freire. Rio de Janeiro: Molarinho and Mont'Alverne.

This volume consists of a number of memoirs on chemical and micro-biological subjects. They are respectively entitled:—Notice on the colouring matter of *Solanum nigrum*, and on an animalcule developed in the juice of the plant; experiments on the part played by the gases of urine; points of contact between homology, molecular weight, and density in reference to water; on an aldehyd isomeric with ordinary acetaldehyd; chemical analysis of one of the springs of the Gamboa; examination of a linseed sophisticated with resin oils and other impurities; reflections on the part played in chemistry by weight, volume, and number; study on pereirine; researches on a cryptogamous plant; the cause of the oxidation of oils; influence of chemical agents on oily fermentation; on vieirine; on the action of oxidising agents upon natural alkaloids; a new calculation for finding the molecular weight, the vapour-density being known; and researches on the rancidification of butter. The last, and probably the most important, paper, "On the Cause, Nature, and Treatment of Yellow Fever," is of a medical rather than of a chemical nature. The author has discovered in the blood of persons suffering from this disease a figured and organised ferment which attacks and destroys the blood globules. He seeks to destroy this enemy by the hypodermic injection of solutions of sodium salicylate. He considers that these microbia are introduced through the digestive organs, especially as he has found both in butter and in the milk of the cocoa corpuscules similar to those detected in the blood of yellow fever patients. He observes that electric action in the atmosphere gives greater activity to the multiplication of the ferment, just as it stimulates the development of higher plants. Thunderstorms have a most disastrous influence both on the virulence and the spread of the fever. This fact may be taken into account by those who still uphold the sanitary influence of ozone, since this body is always considered to be produced by electric action in the atmosphere.

The rancidity of butter he considers due to the development of cryptococci which live at the expense of the caseine and of the complex mixture of fatty ethers which form butter. Hence he pronounces the use of such butter unsafe, it being a mass of microscopic vegetation.

The oxidation of oils he finds is in like manner due not to the mere action of oxygen, but to a fungus which he names *Microclados olecrum*. This microphyte cannot develop in oils containing phenol, arsenious acid, or copper sulphate. It will be seen that Dr. Freire is zealously contributing to work out the mine of discovery which has been opened by Pasteur. This class of research is particularly interesting, as lying on the boundary line between chemistry and biology, and as enriching both these sciences at once. As regards the practical applications of the new theory of ferments, it may surely be said that if Dr. Freire's proposal for the treatment of yellow fever is confirmed by further experience he will be entitled to rank among the greatest benefactors of the human race.

CORRESPONDENCE.

AN EXAMINATION QUESTION.

To the Editor of the Chemical News.

Sir,—Will you kindly allow me a small space to ask "F.I.C." what fault he finds in the terms of the question (set at the late Natural Science Studentship at Christ Church) to which he refers in last week's Chemical News.—I am, &c.,

H. B. Dixon.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Justus Liebig's Annalen der Chemie, Heft 2, 1880.

Decomposition- and Transformation-Products of Uranyl-sulphide.—Clemens Zimmermann.—The metals of the so-called ammonium sulphide group display a varying permanence in their compounds, decreasing from zinc sulphide through cobaltous, nickelous, manganous, and ferrous sulphide, and becoming slightest in the sulphur compound of uranium. The last metal may be regarded as a connecting link between those metals which are precipitated by ammonium sulphide as sulphides, and such as are precipitated as hydroxides, just as lithium forms the transition between the alkalies and the alkaline earths. Zinc, nickel, and cobalt, whose oxides are less numerous, retain sulphur more firmly than manganese or iron. Uranium, which according to our present knowledge forms no fewer than nine oxides, has the slightest affinity for sulphur. This is especially manifested in the uranyl salts, which, even in their sulphides, retain oxygen. Remelé mentions that uranyl sulphide is partially soluble in ammonium sulphide, which, according to the author, is due to the presence of carbonic acid. Ammonium carbonate and the carbonates of the fixed alkalies prevent the precipitation of the uranyl salts by ammonium sulphide, or re-dissolve the precipitate if they are added subsequently. If uranyl sulphide is heated to 40° or 50° with the supernatant liquid containing ammonium sulphide till the latter is decomposed, there results a grey-black mixture of uranous oxide and sulphur, whilst the liquid becomes perfectly limpid. This behaviour of uranyl sulphide has been utilised for the separation of uranium from the alkalies. The author has satisfied himself that this method is trustworthy, the uranyl sulphide being completely resolved into uranous oxide and sulphur. Precipitated uranium sulphide, on prolonged contact with ammonium sulphide in the cold, undergoes changes. The chocolate-coloured substance under certain circumstances becomes either red or black. The former if allowed to stand in contact with the precipitant from twenty-four to forty-eight hours in the cold with access of air gives a splendid blood-red body, "uranium-red." If the air is excluded, and if the ammonium sulphide is free from hyposulphites, a black compound is formed. The formula of the black product is probably $3Ur_2O_3+UrO$. That of uranium-red is probably $Ur_6SK_2O_9$.

Reaction of the Uranyl Salts with Turmeric Paper.—Clemens Zimmermann.—Soluble uranyl salts colour blue litmus slightly reddish, and turmeric paper more or less brown, even if the solutions are very dilute. The brown colour produced is intermediate between that caused by alkalies and that given by boric acid. From the reaction of the former it is distinguished by its production in slightly acid solution, and from the latter by the fact that it disappears on the addition of free mineral acids, and is prevented by the presence of an excess of acetic acid. The brown colour is further converted to a violet-black if the paper is touched with dilute sodium carbonate, and the original yellow of the turmeric paper is restored by subsequently moistening with hydrochloric acid. The brownish red colour produced by boric acid is, according to Vogel and Ludwig, turned blue or black by sodium carbonate, and re-converted to a reddish brown by hydrochloric acid.

Separation of the Heavy Metals of the Ammonium Sulphide Group.—In vol. 199, p. 1, the author gave a method of separating zinc from the remaining metals of he group based on the insolubility of zinc sulphide in dilute hydro-sulphocyanic acid. As an essential precaution he recommended accurate neutralisation of the liquid, which is then mixed with ammonium sulphocyanide and saturated with hydrogen sulphide. He has subsequently applied directly and successively hydro-sulphocyanic acid, which he obtains as follows:—2 parts basic sugar of lead are precipitated with 1 part ammonium sulphocyanide, keeping the flask continually shaken. The lead sulphocyanide thus obtained is washed with cold water, decomposed with hydrogen sulphide, agitating from time to time, and freed from lead sulphide by filtration. Hydrogen sulphide is expelled from the liquid by blowing in air.

Hydrolytic Actions of the Pancreas, Duodenum, Jejunum, and Ileum.—H. T. Brown and J. Heron.—The action of artificial pancreatic juice upon starch-paste at 40° is, in the first stages of the reaction, equal to that of unheated extract of malt at 60°; the composition of the starch products in both cases undergoes no further notable change when 80·8 per cent of maltose have been formed. Pancreatic diastase is capable of slowly converting maltose into dextrose—a change which malt-diastase is incapable of producing. Neither artificial pancreatic juice nor the tissue of the gland itself contains any ferment capable of inverting cane-sugar. The lesser intestines can invert cane-sugar, hydrolise maltose, and effect slightly the transformation of starch.

Vapour Tensions of Homologous Series and Kopp's Law of Constant Differences of Boiling-Points.—A. Winkelmann.—The direct examination of Kopp's law, based upon the observations of Landolt, does not warrant a denial of the general applicability of the law.

Heft 3, 1880.

The Distribution of Atoms in the Molecule.—W. Lossen.—This treatise, which fills up the entire number, does not admit of fair abstraction in the space at our disposal. The author criticises the views of Kekulé, Kolbe, Naumann, L. Meyer, O. E. Meyer, and Mendelejeff. He remarks that we must in the first place represent to ourselves what masses exist within the space of the molecule. It is especially Kekulé's merit to have cautioned chemists not to be content with the contemplation of a divisible mass within the molecule, and that the action of every single indivisible mass, every atom, must be investigated. It does not seem to have been sufficiently considered that the action of the indivisible mass emanates from the *whole* indivisible mass. In consequence of the neglect of this principle, we ascribe to fractions of the atoms an efficacy which can only be ascribed to the atoms themselves, and we turn away our attention from the distribution of the atoms in space.

MISCELLANEOUS.

Royal Agricultural College, Cirencester.—The approaching vacancy in the Chair of Theoretical and Agricultural Chemistry at this College has been filled by the appointment of Professor Edward Kinch, F.C.S., F.I.C., &c., Professor of Chemistry in the Imperial College of Agriculture, Tokio, Japan. Professor Kinch has already been connected with the College, having for three and a half years been Senior Assistant there to Professor Church, where he earned the respect and attachment of Professors and Students by his patient and able teaching, and genial qualities. Subsequently for three years he held the post of Demonstrator, under Dr. Frankland, at the Royal College of Chemistry, and was for a year Superintendent of the Mineral Department, and Chemist to the Indian Museum. He was recommended to the Japanese Government for the Professorship of General and Agricultural Chemistry in the Imperial College, which office he has now held for four years. He has exercised a powerful and beneficial influence over the large number of Students who have passed under his charge, both in this country and Japan, and is known to be an efficient practical teacher, a successful lecturer, and agreeable collaborateur. The resignation of his post in Japan has been received by the Government and Students with great regret, and it is arranged that he will enter upon his duties at the Royal Agricultural College, at the opening of the ensuing Session in May next.

Society of Chemical Industry.—The inaugural meeting of the above proposed Society will be held in the rooms of the Chemical Society, Burlington House, Piccadilly, London, W., on Monday, April 4th, at four o'clock in the afternoon. This Society is not intended to represent any one particular branch of Chemical Industry. It is hoped that it will be representative of many manufactures—Alkali-making, Manure-making, the Textile Colour industries, the Glass and Pottery manufactures, Tar Distilling, Soap-making, Sugar-making, Brewing, Metallurgy, the manufacture of fine Chemicals, and all other industries which show any connection with Chemical Science.

At the last general meeting of the Sub-Committee, held at the Owens College, Manchester, on December 4, 1880, it was resolved that a Society of Chemical Engineers be established, and a Sub-Committee was appointed to make preparations for this meeting, and for considering the details of the scheme. It is not necessary to go into particulars: suffice it to say that for some time the want of a Society has been felt, the object of which is the advancement of Manufacturing Chemistry in the United Kingdom. In order to accomplish this it is desirable to establish a Society which may be the means of bringing together, at stated intervals, all those who possess chemical, physical, and engineering knowledge, and who use this knowledge in the utilisation of chemical action on a manufacturing scale, and who have the charge of, or an interest in, chemical industries. It may indeed prove afterwards desirable to found a distinct branch of the Engineering Profession, to be composed of persons who possess the aforesaid knowledge, and who may be designated as Chemical Engineers. It is unnecessary to state the advantages which would doubtless accrue to the various branches of chemical industry by the training in all chemical, physical, and engineering matters connected with the business, of all those who have charge of processes; but independent of this, such a Society as is proposed to be established would have certain objects in view, which may be briefly stated as follows:—

To enable persons interested in Chemical Industries to meet, to correspond, and interchange ideas respecting improvements in the various processes. To publish information relating to the aforesaid, by means of a *Journal* or otherwise. To acquire and dispose of property for such purposes, and to do all other things incidental or conducive to the above-named objects, or any of them.

It is proposed that the Society shall consist of Members, Associates, Students, and Honorary Members. Members may consist of persons who by their attainments may be considered by the Council to be eligible. Associates may consist of persons practically engaged in such matters, and considered by the Council and Local Committees to be eligible. Students may be those who are disqualified by age or otherwise from election as Members or Associates. Honorary Members must be selected by reason of their distinction in matters relating to Chemical Industry.

It is proposed to hold Annual General Meetings at such times and places as may be decided upon at each Annual Meeting, and further, it is proposed to organise district or local sections, branches of the parent Society, at which Members and Associates may meet oftener and more conveniently than would be possible if only Annual Meetings were held.

A resolution will be proposed at the meeting to this effect:—"That all who subscribe their names to the memorandum shall be admitted as first members of the Society without the payment of any entrance fee."

NOTES AND QUERIES.

⁂ Our Notes and Queries column was opened for the purpose of giving and obtaining information likely to be of use to our readers generally. We cannot undertake to let this column be the means of transmitting merely private information, or such trade notices as should legitimately come in the advertising columns.

Patent Dryers.—In reply to "L. A.," in yours of the 25th, the article used for patent dryers is ground sulphate of manganese. It ought not to contain naturally barium and calcium carbonate.—Geo. G. Blackwell.

MEETINGS FOR THE WEEK

Monday, 4th.—Medical, 8.30.
—— Royal Institution. General Monthly Meeting, 5.
—— Society of Arts, 8. "The Art of Lace-making," Alan S. Cole.
Tuesday, 5th.—Royal Institution, 3 p.m. "The Blood," Prof. Schäfer.
—— Civil Engineers, 8.
—— Society of Arts, 8. "Canada; the Old Colony and the New Dominion," E. Hepple Hall.
—— Chemical, 8.30. Faraday Lecture. "On the Modern Development of Faraday's Conception of Electricity," Professor Helmholtz (To be given in the Theatre of the Royal Institution, Albemarle Street).
Wednesday, 6th.—Society of Arts, 8. "The Discrimination and Artistic Use of Precious Stones," Professor A. H. Church, F.C.S.
—— Geological, 8.
—— Pharmaceutical, 8.
Thursday, 7th.—Royal, 4.30.
—— Chemical, 8. "On the Estimation of Hydric Peroxide by means of Potassic Permanganate," W. E. Admey. "On the Action of Compounds Inimical to Bacterial Life," William M. Hamlet.
—— Royal Institution, 3. "Ornament," Mr. H. H. Statham.
Friday, 8th.—Royal Institution, 8. "Conversion of Radiant Heat into Sound," Prof. Tyndall, 9.
—— Quekett, 8.
Saturday, 9th.—Royal Institution, 3. "American Humourists," Rev. H. R. Haweis.
—— Physical, 3. "Note on Thermal Electrolysis," Dr. J. H. Gladstone and Mr. Tribe.

TO CORRESPONDENTS.

J. W. O'Neill.—See notice at the head of our "Notes and Queries" column. We do not know the address of "Olive Oil."

E. L. Marks.—Application must be made to the Secretary of the Chemical Society, Burlington House, Piccadilly, London.

Recently published, price 6s.

A TREATISE ON FUEL: Scientific and Practical. By ROBERT GALLOWAY, M.R.I A., &c.
The best methods of estimating the heating power of fuels, and the technical examination and analysis of the different varieties of coal are fully described; and among the illustrations, drawn to scale, are Siemens's Regenerative Gas Furnace, Pyrometer, &c., with complete descriptions.

By the same Author,

In the Press, and will be published immediately,

EDUCATION, SCIENTIFIC and TECHNICAL; or,
HOW THE INDUCTIVE SCIENCES ARE TAUGHT; and
HOW THEY OUGHT TO BE TAUGHT.

London: TRÜBNER and CO., Ludgate Hill.

BERNERS COLLEGE of CHEMISTRY.

Instruction and preparation in CHEMISTRY and the EXPERIMENTAL SCIENCES under the direction of Professor E. V. GARDNER, F.A.S., M.S.A.
The Class Rooms are open from 11 to 5 a.m. and from 7 to 10 p.m daily.
Especial facilities for persons preparing for Government and other examinations.
Private Pupils will find every convenience.
Analyses, Assays, and Practical Investigations connected with Patents, &c., conducted.
Prospectuses and full particulars on application to Prof Gardner at Berners College, 44, Berners-street W.

Water-Glass, or Soluble Silicates of Soda and Potash, in large or small quantities, and either solid or in solution, at ROBERT RUMNEY'S Ardwick Chemical Works Manchester.

ACIDS.
Wanted, a Working Foerman for a small Nitric and Sulphuric Acid Factory in Australia.—Apply by letter only, stating former employment, salary required, &c., to B. W. Chandler, Esq., 15, King Street, Cheapside, London.

Wanted, a Practical Working Manager for Chemical Works, where the manufacture of vitriol (brown and rectified), muriatic acid, alum, &c., is carried on. Must understand the working of Glover and Gay Lussac towers.—Address, stating salary required, with testimonials and references, to John H. Mycock, Chemical Works, Rotherham.

Wanted, immediately, a Chemical Assistant (English or Foreign), capable of undertaking organic research and able to assist in a general analytical business. Must be well acquainted with the examination of Drugs, &c.—Apply, stating experience and salary expected, to F., Chemical News Office, Boy Court, Ludgate Hill, London, E.C.

Wanted, Chemical Balance and Microscope, second-hand. Also "Watts's Dictionary of Chemistry," complete with Supplements.—Address, stating particulars and lowest price, Box 521, Chemical News Office, Boy Court, Ludgate Hill, London, E.C.

SOLAR PHYSICS.

The following Courses of Lectures will be given by Members of the Committee on Solar Physics, appointed by the Lords of the Committee of Council on Education:—
An Introductory Lecture. By Professor Stokes, Sec. R.S. 6th April, 1881.
A Lecture on the Practical Importance of Studying the Influence of the Sun on Terrestrial Phenomena. By Lieut.-General Strachey R.E., C.S.I., F.R.S. 8th April.
Two Lectures on the Connection between Solar and Terrestrial Phenomena. By Professor Balfour Stewart, F.R.S. 27th and 29th April.
Six Lectures on Spectroscopy in Relation to Solar Chemistry. By Mr. J. Norman Lockyer, F.R.S. 4th, 6th, 11th, 13th, 18th, and 20th May.
Three Lectures on the Photography of the Infra-red of the Spectrum in its Application to Solar Physics. By Captain Abney, R.E., F.R.S. 25th and 27th May and 1st June.
The Lectures will be delivered in the Lecture Theatre of the South Kensington Museum, at 4 p.m., on the days stated above.
Admission will be by Tickets, which may be obtained, as far as there is room, on application by letter to the Secretary, Science and Art Department, South Kensington, S.W.

MR. J. S. MERRY,
ASSAYER AND ANALYTICAL CHEMIST.
SWANSEA.

PURE HYDRATE OF ALUMINA.
A. KEIFFENHEIM & CO.,
27, Side, Newcastle-on-Tyne.

THE CHEMICAL NEWS
AND
JOURNAL OF PHYSICAL SCIENCE.
Edited by WILLIAM CROOKES, F.R.S.

Published every Friday. Price 4d. Annual Subscription, post free including Indices, £1

CHARGES FOR ADVERTISEMENTS.

	£	s.	d.
Five lines in column (about 10 words to line)	0	3	6
Each additional line	0	0	6
Whole column	1	15	0
Whole page	3	0	0

A reduction made for a series o insertions.

Cheques and Post-Office Orders, crossed "London and County Bank," payable to the order of William Crookes.
BOY COURT LUDGATE HILL LONDON, E.C

ROYAL POLYTECHNIC.—The Photophone, popularly explained and illustrated by experiments, The Great Lightning Inductorium; a Popular Astronomical Lecture. illustrated by beautiful Dissolving Views and Effects, &c., by Mr. J. L. King. Musical Sketches of a high and amusing order, by Mr. Eric Lewis. Magical Art in Perfection, by Prof. R. Hellis. Costume Recitals, by Madame Katharine Hickson. Electric Railway. Leotard and Blondin, the Wonderful Automata. Diving Bell, &c. Admission to the whole, 1s. Open from 12 till 5 and from 7 till 10.

EGLINTON ALUM CLAY

(SIMILAR TO, BUT FREER FROM IRON THAN, BAUXITE).

THE EGLINTON CHEMICAL COMPANY, Limited, *who were the first to introduce this substance* to the notice of the Alum Trade, are now supplying it largely to Alum Manufacturers in this country and in America, Germany, and Russia, for the manufacture of Potash Alum and Sulphate of Alumina.

ANALYSIS OF DELIVERIES.

	Dried at 212° F.	
	First Quality.	Second Quality.
Alumina	52·37 per cent.	43·41 per cent.
Peroxide of Iron	1·29 ,,	1·81 ,,
Silica, &c.	19·24 ,,	34·35 ,,
Water of combination ...	27·13 ,,	20·52 ,,
	100·03	100·09

Being Shipowners, THE EGLINTON CHEMICAL CO., Lim., can guarantee regular delivery as may be required, and are prepared to quote a price f.o.b. at their private Harbours at Glenarm and Ballintoy, or delivered at Buyers' Works, in bulk or in bags, ground or unground.

WILLIAM J. A. DONALD, *Secretary and Manager.*

29, St. Vincent Place, Glasgow.

Established 1798.

ROBERT DAGLISH & CO.,

ENGINEERS, BOILER AND BRIDGE MAKERS, MILLWRIGHTS,

BRASS AND IRON FOUNDERS.

Manufacturers of every description of Condensing, or High-pressure Blowing, Pumping, Rolling, Winding, and Patent Steam-engines, of any required power, for Irrigating, Draining, Mining, Rolling Mills, or Water Works purposes, and Manufacturers of every description of Chemical, Colliery, Copper Ore, Gold Mining, Glass, and Rock-salt Machinery.

Black-ash Revolving Furnaces of the Most Approved Type.

Bessemer Steel-Rail Plant.

Compressing-Engines for Collieries, Iron Works, and Weldon's Patent Bleaching-Powder Process.

Caustic, Chlorate, Decomposing, Nitre Nitro-Glycerine, Iodine Potash, Sulphur, Acid, and Oxalic Pans.

Gas Producers Patent for Heating and other Purposes.

Pyrites Burners for Irish, Norwegian, and Spanish Ores of Improved Construction.

Patent Rousing Machinery for Brewers.

Retorts, Acid, Gas, Iodine, Nitric, Nitre Nitro-Glycerine and Vitriol Refining.

Steam Superheaters improved for Oil, Tar, and Resin Refining.

Steam Sulphur Melter.

Stills for Oil, Resin, and Tar.

Wheels, Bevel, Mitre, and Spur Moulded on the Shortest Notice by Patent Machinery.

Makers of Mactear's Patent Carbonating Furnace, Jones and Walsh's Patent Sulphate of Soda Furnace, Parnell and Simpson's Patent Causticiser, and Kynaston's Patent Alum Plan

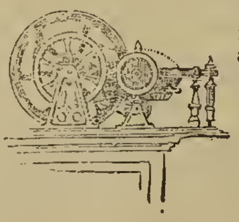
Lists sent on Application.

Photographs, Plans, and other information supplied on receipt of Order.

ST HELEN'S ENGINE, BOILER, AND BRIDGE WORKS
AND FOUNDRY,
LANCASHIRE.

Carr's Patent Paint and Drug Mill.

Approved by some of the most eminent Chemists, and awarded the Silver Prize Medals of the Manchester and Liverpool, and the Middleton Agricultural Shows.



From Messrs. E. H. Smyth & Co., 21 Duke Street, Edinburgh, and 69, Coleman Street, City, London.—The small Levigator Mill we recently got from you works most efficiently, and is a great economiser of time.

The chief feature in this machine is, that although it can be turned with ease by a boy, it has immense frictional power for levigating purposes. This is caused by the runner being driven at a much greater speed, but in the same direction, than the bowl. The surfaces being Minton ware, they are clean, smooth, and durable.

Testimonials on application.

£11 nett cash, delivered in Manchester.

The diameter of the bowl is 18 ins., and it and the runners are made of Minton ware. It is useful for Painters, Chemists, Grocers, and Cooks, for triturating and mixing Medicines, Vegetable Powders, Ointments, Paints, Sugar, Salt, Spices, Herbs, Meat for Potting, and will grind the coarsest Emery into a nearly Impalpable Powder in a few seconds. The pan can be tilted for emptying, as shown in the dotted lines; it can be worked by hand or power.

SOLE MAKERS—
W. H. BAILEY & Co., Albion Works, Salford, Manchester.

WILLIAM AND WILLIAM T. FIELD,

MANUFACTURERS of the Celebrated STAFFORDSHIRE BLUE BRICKS, specially adapted for Chemical Plant, *i.e.*, Acid Towers, &c. Also all other kinds of Best Staffordshire Blue Bricks, Pavings, Plynths, Splays, Copings, &c. &c. Prices and samples on Application.

TESTIMONIAL

"We have used the Blue Staffordshire Brick or Sulphuric Acid Towers, &c., manufactured by Messrs. Field, for the last fifteen years during which time they have given great satisfaction. We recommend them to the Chemical Trade, believing there is nothing better in the market."—(Signed) WILLIAM HUNT and SONS, Lea Brook Alkali Works, near Wednesbury, Staffordshire, February, 1878.

TOLL END BRICK-WORKS,
TIPTON, STAFFORDSHIRE.

THE CHEMICAL NEWS.

Vol. XLIII. No. 1115.

ON THE MODERN DEVELOPMENT OF FARADAY'S CONCEPTION OF ELECTRICITY.*

By Professor HELMHOLTZ.

Mr. President, Ladies, and Gentlemen,—

The majority of Faraday's own researches were connected, directly or indirectly, with questions regarding the nature of electricity, and his most important and most renowned discoveries lay in this field. The facts which he has found are universally known. Nevertheless, the fundamental conceptions by which Faraday has been led to these much-admired discoveries have not been received with much consideration. His principal aim was to express in his new conceptions only facts, with the least possible use of hypothetical substances and forces. This was really a progress in general scientific method, destined to purify science from the last remnants of metaphysics. Now that the mathematical interpretations of Faraday's conceptions regarding the nature of electric and magnetic force has been given by Clerk Maxwell, we see how great a degree of exactness and precision was really hidden behind his words, which to his contemporaries appeared so vague or obscure; and it is astonishing in the highest to see what a large number of general theories the methodical deduction of which requires the highest powers of mathematical analysis, he has found by a kind of intuition, with the security of instinct, without the help of a single mathematical formula.

The electrical researches of Faraday, although embracing a great number of apparently minute and disconnected questions, all of which he has treated with the same careful attention and conscientiousnesss, are really always aiming at two fundamental problems of natural philosophy, the one more regarding the nature of physical forces, or of forces working at a distance; the other, in the same way, regarding chemical forces, or those which act from molecule to molecule, and the relation between these and the first.

The great fundamental problem which Faraday called up anew for discussion was the existence of forces working directly at a distance without any intervening medium. During the last and the beginning of the present century the model after the likeness of which nearly all physical theories had been formed was the force of gravitation acting between the sun, the planets, and their satellites. It is known how, with much caution and even reluctance, Sir Isaac Newton himself proposed his grand hypothesis, which was destined to become the first great and imposing example, illustrating the power of true scientific method.

But then came Oerstedt's discovery of the motions of magnets under the influence of electric currents. The force acting in these phenomena had a new and very singular character. It seemed as if it would drive a single isolated pole of a magnet in a circle around the wire conducting the current, on and on without end, never coming to rest. Faraday saw that a motion of this kind could not be produced by any force of attraction or repulsion, working from point to point. If the current is able to increase the velocity of the magnet, the magnet must react on the current. So he made the experiment, and discovered induced currents; he traced them out through all the various conditions under which they ought to appear. He concluded that somewhere in a part of the space traversed by magnetic force there exists a peculiar state of tension, and that every change of this tension produces electromotive force. This unknown hypothetical state he called provisionally the electrotonic state, and he was occupied for years and years in finding out what was this electrotonic state. He discovered at first, in 1838, the dielectric polarisation of electric insulators, subject to electric forces. Such bodies show, under the influence of electric forces, phenomena perfectly analogous to those exhibited by soft iron under the influence of the magnetic force. Eleven years later, in 1849, he was able to demonstrate that all ponderable matter is magnetised under the influence of sufficiently intense magnetic force, and at the same time he discovered the phenomena of diamagnetism, which indicated that even space, devoid of all ponderable matter, is magnetisable; and now with quite a wonderful sagacity and intellectual precision Faraday performed in his brain the work of a great mathematician without using a single mathematical formula. He saw with his mind's eye that by these systems of tensions and pressures produced by the dielectric and magnetic polarisation of space which surrounds electrified bodies, magnets or wires conducting electric currents, all the phenomena of electro-static, magnetic, electro-magnetic attraction, repulsion, and induction could be explained, without recurrring at all to forces acting directly at a distance. This was the part of his path where so few could follow him; perhaps a Clerk Maxwell, a second man of the same power and independence of intellect, was necessary to reconstruct in the normal methods of science the great building, the plan of which Faraday had conceived in his mind and attempted to make visible to his contemporaries.

Nevertheless the adherents of direct action at a distance have not yet ceased to search for solutions of the electromagnetic problem. The present development of science, however, shows, as I think, a state of things very favourable to the hope that Faraday's fundamental conceptions may in the immediate future receive general assent. His theory, indeed, is the only existing one which is at the same time in perfect harmony with the facts observed, and which at least does not lead into any contradiction against the general axioms of dynamics.

It is not at all necessary to accept any definite opinion about the ultimate nature of the agent which we call electricity.

Faraday himself avoided as much as he could giving any affirmative assertion regarding this problem, although he did not conceal his disinclination to believe in the existence of two opposite electric fluids.

For our own discussion of the electro-chemical phenomena, to which we shall turn now, I beg permission to use the language of the old dualistic theory, because we shall have to speak principally on relations of quantity.

I now turn to the second fundamental problem aimed at by Faraday, the connection between electric and chemical force. Already, before Faraday went to work, an elaborate electro-chemical theory had been established by the renowned Swedish chemist, Berzelius, which formed the connecting-link of the great work of his life, the systematisation of the chemical knowledge of his time. His starting point was the series into which Volta had arranged the metals according to the electric tension which they exhibit after contact with each other. A fundamental point which Faraday's experiment contradicted was the supposition that the quantity of electricity collected in each atom was dependent on their mutual electro-chemical differences, which he considered as the cause of their apparently greater chemical affinity. But although the fundamental conceptions of Berzelius's theory have been forsaken, chemists have not ceased to speak of positive and negative constituents of a compound body. Nobody can overlook that such a contrast of qualities, as

---

* The Faraday Lecture, delivered before the Fellows of the Chemical Society in the Theatre of the Royal Institution, on Tuesday, April 5th, 1881, by Professor Helmholtz. Abstract revised by the Author.

was expressed in Berzelius's theory, really exists, well-developed at the extremities, less evident in the middle terms of the series, playing an important part in all chemical actions, although often subordinated to other influences.

When Faraday began to study the phenomena of decomposition by the galvanic current, which of course were considered by Berzelius as one of the firmest supports of his theory, he put a very simple question; the first question, indeed, which every chemist speculating about electrolysis ought to have answered. He asked, What is the quantity of electrolytic decomposition if the same quantity of electricity is sent through several electrolytic cells? By this investigation he discovered that most important law, generally known under his name, but called by him the law of definite electrolytic action.

Faraday concluded from his experiments that a definite quantity of electricity cannot pass a voltametric cell containing acidulated water between electrodes of platinum without setting free at the negative electrode a corresponding definite amount of hydrogen, and at the positive electrode the equivalent quantity of oxygen, one atom of oxygen for every pair of atoms of hydrogen. If instead of hydrogen any other element capable of substituting hydrogen is separated from the electrolyte, this is done also in a quantity exactly equivalent to the quantity of hydrogen which would have been evolved by the same electric current.

Since that time our experimental methods and our knowledge of the laws of electrical phenomena have made enormous progress, and a great many obstacles have now been removed which entangled every one of Faraday's steps, and obliged him to fight with the confused ideas and ill-applied theoretical conceptions of some of his contemporaries. We need not hesitate to say that the more experimental methods were refined, the more the exactness and generality of Faraday's law was confirmed.

In the beginning Berzelius and the adherents of Volta's original theory of galvanism, based on the effects of metallic contact, raised many objections against Faraday's law. By the combination of Nobili's astatic pairs of magnetic needles with Schweigger's multiplicator, a coil of copper wire with numerous circumvolutions, galvanometers became so delicate that the electro-chemical equivalent of the smaller currents they indicated was imperceptible for all chemical methods. With the newest galvanometers you can very well observe currents which would want to last a century before decomposing one milligram of water, the smallest quantity which is usually weighed on chemical balances. You see that if such a current lasts only some seconds or some minutes, there is not the slightest hope to discover its products of decomposition by chemical analysis. And even if it should last a long time the feeble quantities of hydrogen collected at the negative electrode can vanish, because they combine with the traces of atmospheric oxygen absorbed by the liquid. Under such conditions a feeble current may continue as long as you like without producing any visible trace of electrolysis, even not of galvanic polarisation, the appearance of which can be used as an indication of previous electrolysis. Galvanic polarisation, as you know, is an altered state of the metallic plates which have been used as electrodes during the decomposition of an electrolyte. Polarised electrodes, when connected by a galvanometer, give a current which they did not give before being polarised. By this current the plates are discharged again and returned to their original state of equality.

This depolarising current is indeed a most delicate means of discovering previous decomposition. I have really ascertained that under favourable conditions one can observe the polarisation produced during some seconds by a current which decomposes one milligram of water in a century.

Products of decomposition cannot appear at the electrodes without motions of the constituent molecules of the electrolyte throughout the whole length of the liquid. This subject has been studied very carefully and for a great number of liquids, by Prof. Hittorff, of Münster, and Prof. G. Wiedemann, of Leipsic.

Prof. F. Kohlrausch, of Würzburg, has brought to light the very important fact that in diluted solutions of salts, including hydrates of acids and hydrates of caustic alkalies, every atom under the influence of currents of the same density moves on with its own peculiar velocity, independently of other atoms moving at the same time in the same or in opposite directions. The total amount of chemical motion in every section of the fluid is represented by the sum of the equivalents of the cation gone forwards and of the anion gone backwards, in the same way as in the dualistic theory of electricity, and the total amount of electricity flowing through a section of the conductor corresponds to the sum of positive electricity going forwards and negative electricity going backwards.

This established, Faraday's law tells us that through each section of an electrolytic conductor we have always equivalent electrical and chemical motion. The same definite quantity of either positive or negative electricity moves always with each univalent ion, or with every unit of affinity of a multivalent ion, and accompanies it during all its motions through the interior of the electrolytic fluid. This we may call the electric charge of the atom.

Now the most startling result, perhaps, of Faraday's law is this: If we accept the hypothesis that the elementary substances are composed of atoms we cannot avoid concluding that electricity also, positive as well as negative, is divided into definite elementary portions, which behave like atoms of electricity. As long as it moves about on the electrolytic liquid each atom remains united with its electric equivalent or equivalents. At the surface of the electrodes decomposition can take place if there is sufficient electromotive power, and then the atoms give off their electric charges and become electrically neutral.

Now arises the question, Are all these relations between electricity and chemical combination limited to that class of bodies which we know as electrolytes? In order to produce a current of sufficient strength to collect enough of the products of decomposition without producing too much heat in the electrolyte, the substance which we try to decompose ought not to have too much resistance against the current. But this resistance may be very great, and the motion of the ions may be very slow, so slow indeed that we should need to allow it to go on for hundreds of years before we should be able to collect even traces of the products of decomposition; nevertheless all the essential attributes of the process of electrolysis could subsist. If you connect an electrified conductor with one of the electrodes of a cell filled with oil of turpentine, the other with the earth, you will find that the electricity of the conductor is discharged unmistakably more rapidly through the oil of turpentine than if you take it away and fill the cell only with air.

Also in this case we may observe polarisation of the electrodes as a symptom of previous electrolysis. Another sign of electrolytic conduction is that liquids brought between two different metals produce an electromotive force. This is never done by metals of equal temperature, or other conductors which, like metals, let electricity pass without being decomposed.

The same effect is also observed even with a great many rigid bodies, although we have very few solid bodies which allow us to observe this electrolytic conduction with the galvanometer, and even these only at temperatures near to their melting-point. It is nearly impossible to shelter the quadrants of a delicate electrometer against being charged by the insulating bodies by which they are supported.

In all the cases which I have quoted one might suspect that traces of humidity absorbed by the substance or adhering to their surface were the electrolytes. I show you therefore this little Daniell's cell, in which the porous septum has been substituted by a thin stratum of glass. Externally all is symmetrical at both poles; there is nothing in contact with the air but a closed surface of glass, through which two wires of platinum penetrate. The whole charges the electrometer exactly like a Daniell's cell of very great resistance, and this it would not do if the septum of glass did not behave like an electrolyte. All these facts show that electrolytic conduction is not at all limited to solutions of acids or salts.

Hitherto we have studied the motions of ponderable matter as well as of electricity, going on in an electrolyte. Let us study now the forces which are able to produce these motions. It has always appeared somewhat startling to everybody who knows the mighty power of chemical forces, the enormous quantity of heat and of mechanical work which they are able to produce, and who compares with it the exceedingly small electric attraction which the poles of a battery of two Daniell's cells show. Nevertheless this little apparatus is able to decompose water.

The quantity of electricity which can be conveyed by a very small quantity of hydrogen, when measured by its electrostatic forces, is exceedingly great. Faraday saw this, and has endeavoured in various ways to give at least an approximate determination. The most powerful batteries of Leyden jars, discharged through a voltameter, give scarcely any visible traces of gases. At present we can give definite numbers. The result is that the electricity of 1 m.grm. of water, separated and communicated to two balls, 1 kilometre distant, would produce an attraction between them, equal to the weight of 25,000 kilos.

The total force exerted by the attraction of an electrified body upon another charged with opposite electricity is always proportional to the quantity of electricity contained in the attracting as on the attracted body, and therefore even the feeble electric tension of two Daniell's elements, acting through an electrolytic cell upon the enormous quantities of electricity with which the constituent ions of water are charged, is mighty enough to separate these elements and to keep them separated.

We now turn to investigate what motions of the ponderable molecules require the action of these forces. Let us begin with the case where the conducting liquid is surrounded everywhere by insulating bodies. Then no electricity can enter, none can go out through its surface, but positive electricity can be driven to one side, negative to the other, by the attracting and repelling forces of external electrified bodies. This process going on as well in every metallic conductor is called "electrostatic induction." Liquid conductors behave quite like metals under these conditions. Prof. Wüllner has proved that even our best insulators, exposed to electric forces for a long time, are charged at last quite in the same way as metals would be charged in an instant. There can be no doubt that even electromotive forces going down to less than $\frac{1}{100}$ Daniell produce perfect electrical equilibrium in the interior of an electrolytic liquid.

Another somewhat modified instance of the same effects is afforded by a voltametric cell containing two electrodes of platinum, which are connected with a Daniell's cell, the electromotive force of which is insufficient to decompose the electrolyte. Under this condition the ions carried to the electrodes cannot give off their electric charges. The whole apparatus behaves, as was first accentuated by Sir W. Thomson, like a condenser of enormous capacity.

Observing the polarising and depolarising currents in a cell containing two electrodes of platinum, hermetically sealed and freed of all air, we can observe these phenomena with the most feeble electromotive forces of $\frac{1}{1000}$ Daniell, and I found that down to this limit the capacity of the platinum surfaces proved to be constant. By taking greater surfaces of platinum I suppose it will be possible to reach a limit much lower than that. If any chemical force existed besides that of the electrical charges which could bind all the pairs of opposite ions together, and require any amount of work to be vanquished, an inferior limit to the electromotive forces ought to exist, which forces are able to attract the atoms to the electrodes and to charge these as condensers. No phenomenon indicating such a limit has as yet been discovered, and we must conclude therefore that no other force resists the motions of the ions through the interior of the liquid than the mutual attractions of their electric charges.

On the contrary, as soon as an ion is to be separated from its electrical charge we find that the electrical forces of the battery meet with a powerful resistance, the overpowering of which requires a good deal of work to be done. Usually the ions, losing their electric charges, are separated at the same time from the liquid; some of them are evolved as gases, others are deposited as rigid strata on the surface of the electrodes, like galvanoplastic copper. But the union of two constituents having powerful affinity to form a chemical compound, as you know very well, produces always a great amount of heat, and heat is equivalent to work. On the contrary, decomposition of the compound substances requires work, because it restores the energy of the chemical forces, which has been spent by the act of combination.

Metals uniting with oxygen or halogens produce heat in the same way, some of them, like potassium, sodium, zinc, even more heat than an equivalent quantity of hydrogen; less oxidisible metals, like copper, silver, platinum, less. We find therefore that heat is generated when zinc drives copper out of its combination with the compound halogen of sulphuric acid, as is the case in a Daniell's cell.

If a galvanic current passes through any conductor, a metallic wire, or an electrolytic fluid, it evolves heat. Mr. Prescott Joule was the first who proved experimentally that if no other work is done by the current the total amount of heat evolved in a galvanic circuit during a certain time is exactly equal to that which ought to have been generated by the chemical actions which have been performed during that time. But this heat is not evolved at the surface of the electrodes, where these chemical actions take place, but is evolved in all the parts of the circuit, proportionally to the galvanic resistance of every part. From this it is evident that the heat evolved is an immediate effect, not of the chemical action, but of the galvanic current, and that the chemical work of the battery has been spent in producing only the electric action.

If we apply Faraday's law, a definite amount of electricity passing through the circuit corresponds to a definite amount of chemical decomposition going on in every electrolytic cell of the same circuit. According to the theory of electricity the work done by such a definite quantity of electricity which passes, producing a current, is proportionate to the electromotive force acting between both ends of the conductor. You, see therefore, that the electromotive force of a galvanic circuit must be, and is indeed, proportionate to the heat generated by the sum of all the chemical actions going on in all the electrolytic cells during the passage of the same quantity of electricity. In cells of the galvanic battery chemical forces are brought into action able to produce work; in cells in which decomposition is occurring work must be done against opposing chemical forces; the rest of the work done appears as heat evolved by the current, as far as it is not used up to produce motions of magnets or other equivalents of work.

Hitherto we have supposed that the ion with its electric charge is separated from the fluid. But the ponderable atoms can give off their electricity to the electrode, and remain in the liquid, being now electrically neutral. This makes almost no difference in the value of the electromotive force. For instance, if chlorine is separated at the anode, it will remain at first absorbed by the liquid; if the solution becomes saturated, or if we make a vacuum over the liquid, the gas will rise in bubbles. The electromotive force remains unaltered. The same may be observed with all the other gases. You see in this case that the change of electrically negative chlorine into neutral chlorine is the process which requires so great an amount of work, even if the ponderable matter of the atoms remains where it was.

The more the surface of the positive electrode is covered with negative atoms of the anion, and the negative with the positive ones of the cation, the more the attracting force of the electrodes exerted upon the ions of the liquid is diminished by this second stratum of opposite electricity covering them. On the contrary, the force with which the positive electricity of an atom of hydrogen is attracted towards the negatively charged metal increases in proportion as more negative electricity collects before it on the metal, and the more negative electricity collects behind it in the fluid.

Such is the mechanism by which electric force is concentrated and increased in its intensity to such a degree that it becomes able to overpower the mightiest chemical affinities we know of. If this can be done by a polarised surface, acting like a condenser, charged by a very moderate electromotive force, can the attractions between the enormous electric charges of anions and cations play an unimportant and indifferent part in chemical affinity?

You see, therefore, if we use the language of the dualistic theory and treat positive and negative electricities as two substances, the phenomena are the same as if equivalents of positive and negative electricity were attracted by different atoms, and perhaps also by the different values of affinity belonging to the same atom with different force. Potassium, sodium, zinc, must have strong attraction to a positive charge; oxygen, chlorine, bromine to a negative charge.

Faraday very often recurs to this to express his conviction that the forces termed chemical affinity and electricity are one and the same. I have endeavoured to give you a survey of the facts in their mutual connection, avoiding, as far as possible, introducing other hypotheses, except the atomic theory of modern chemistry. I think the facts leave no doubt that the very mightiest among the chemical forces are of electric origin. The atoms cling to their electric charges and the opposite electric charges cling to the atoms. But I don't suppose that other molecular forces are excluded, working directly from atom to atom. Several of our leading chemists have begun lately to distinguish two classes of compounds, molecular aggregates and typical compounds. The latter are united by atomic affinities, the former not. Electrolytes belong to the latter class.

If we conclude from the facts that every unit of affinity of every atom is charged always with one equivalent either of positive or of negative electricity, they can form compounds, being electrically neutral, only if every unit charged positively unites under the influence of a mighty electric attraction with another unit charged negatively. You see that this ought to produce compounds in which every unit of affinity of every atom is connected with one and only with one other unit of another atom. This is, as you will see immediately, indeed, the modern chemical theory of quantivalence, comprising all the saturated compounds. The fact that even elementary substances, with few exceptions, have molecules composed of two atoms, makes it probable that even in these cases electric neutralisation is produced by the combination of two atoms, each charged with its electric equivalent, not by neutralisation of every single unit of affinity.

But I abstain from entering into mere specialities, as, for instance, the question of unsaturated compounds; perhaps I have gone already too far. I would not have dared to do it if I did not feel myself sheltered by the authority of that great man who was guided by a never-erring instinct of truth. I thought that the best I could do for his memory was to recall to the minds of the men, by the energy and intelligence of whom chemistry has undergone its modern astonishing development, what important treasures of knowledge lie still hidden in the works of that wonderful genius. I am not sufficiently acquainted with chemistry to be confident that I have given the right interpretation, that interpretation which Faraday himself would have given perhaps, if he had known the law of chemical quantivalence, if he had had the experimental means of ascertaining how large the extent, how unexceptional the accuracy of his law really is: and if he had known the precise formulation of the law of energy applied to chemical work, and of the laws which determine the distribution of electric forces in space as well as in ponderable bodies transmitting electric current or forming condensers. I shall consider my work of to-day well rewarded if I have succeeded in kindling anew the interest of chemists for the electro-chemical part of their science.

FURTHER CONTRIBUTIONS TO THE CHEMISTRY OF BAST FIBRES.*

By E. J. BEVAN and C. F. CROSS.

In our first paper on this subject (April, 1880) we were able to report some considerable progress towards a solution, in general terms, of the problems presented in this field of natural chemistry: our subsequent researches have led us to certain more precise conclusions, while confirming the general view which we advanced, especially in reference to the aromatic constituents of these fibres; and we think they are of sufficient importance and certainty to justify this brief anticipation of their publication in detail. Witholding, then, for the present their formal development, we may state their main result, which is to identify the aromatic bodies in question with the *tannins*. The formula which we worked out for the product of chlorination of the jute fibre (*i e.*, its aromatic constituent) was, it will be remembered, $C_{19}H_{18}Cl_4O_9$. This body bears a certain resemblance to chloranil, sufficiently close as, with its more complicated structure and amorphous nature, to warrant our regarding it as a quinone derivative. We were further struck with the analogy of the formula with certain others representing products of plant growth, *e.g.*, aloin, $C_{17}H_{18}O_7$, luteolin, $C_{20}H_{14}O_8$; this is especially the case with catechin, $C_{19}H_{18}O_8$, as we afterwards discovered. Now, in passing to a comparative investigation of this body we found that both it and the tannic acid, with which it is associated in catechin, yielded on treatment with potassium chlorate and hydrochloric acid, the same tetrachlorinated derivative, $C_{20}H_{19}Cl_4O_{12}$, a body not only similar in composition to that formulated above, but having the same characteristics. We next found that catechu, and pure tannin itself, gave on treatment with chlorine, followed by Na_2SO_3, the brilliant magenta colouration which we described as characteristic of bast fibres under the same treatment. Having, moreover, a specimen of decayed jute at hand we investigated it in the light of these results, and succeeded in isolating a quantity of a tannin, evidently a product of the degradation of the fibre; the normal jute (from the same bale) containing traces only of matters soluble in water. Further, the "resinous" substance obtained as a precipitate from the alkaline extract of the esparto fibre, on neutralising, was converted, by heating under pressure with Na_2SO_3 (solution), into a soluble modification, which was identified as a tannin. This conclusion, that the characteristic constituent of bast fibres is a (potential) tannin, not only harmonises all our theoretical results, but throws great light on the technology of the subject. The affinities of jute, which we may take as typical, for colouring-matters are precisely those of tannin-mordanted cotton. The destruction of the jute fibre under the action of superheated steam, and its prevention, which has been made the sub-

---

* Read before the Owens College Chemical Society, April 2, 1881.

ject of a recent patent by one of us, are exactly parallel with the behaviour of tannin under the same conditions. Certain points in connection with this part of the subject are still under investigation, as is also the chemistry of the carbohydrate with which this bast tannin is associated. These, together with the more important physiological problems, we hope also in some measure to elucidate before publishing our researches *in extenso*.

A NEW ALKALIMETRIC INDICATOR.

By H. W. LANGBECK.

Nitro-phenic acid dissolved in 100,000 parts of distilled water presents a nearly colourless liquid, but if a trace only of an alkali be added a distinct yellow colour appears. This delicate indicator is, of course, only useful if colourless or slightly coloured fluids are to be examined. In determining, for instance, the temporary hardness of water, I dissolve 1 part of nitro-phenic acid in 5000 parts of distilled water, I also prepare centinormal potash and acetic acid solutions. 100 c.c. of distilled water are put into one Nessler glass, the same quantity into another, and again 100 c.c. of the water to be examined into a third. To each of them 5 c.c. of nitro-phenic acid solution are added (one is kept for comparing), which leaves the distilled water nearly colourless, while the common water turns yellow to deep yellow according to hardness. From a burette centinormal potash solution is then added to the one glass of distilled water until the colour is of the same shade as the common water: each c.c. used is equal to 0·00028 of lime, CaO. To verify the result, centinormal acetic acid is added until the first shade (nearly colourless) returns: the quantity of acid required is, of course, the same as the alkali. The common water is now also treated with the centinormal acid until the first shade is reached: each c.c. used equals 0·0005 of carbonate of lime.

I compared, for instance, 100 c.c. of distilled water with 100 c.c. of water of the East London Company. The distilled water required 1·9 centinormal potash solution to colour it the same shade as the common water, and also 1·9 c.c. of acid to become nearly colourless again: the water in question contained, therefore, 0·532 lime (CaO) in 100,000 parts. The common water required 29·8 c.c. to return to the first shade. From this quantity 1·9 = lime found must be deducted. Each of the remaining c.c. is equal to 0·0005 carbonate of lime, = 13·95 in 100,000 parts, or total temporary hardness = 14·482.

ON THE

ESTIMATION OF PEROXIDE OF HYDROGEN.

(Reply to Dr. Em. Schöne.)

By C. T. KINGZETT, F.C.S., F.I.C.

As an advocate of the exercise of criticism in scientific work, I cannot shrink from it when directed against my own investigations. I therefore address myself to the task of answering Dr. Schöne's remarks (Chemical News, vol. xliii., p. 149), so that the readers of these columns may judge between my critic and me.

Dr. Schöne is correct in stating that I recommend the use of a great excess of dilute sulphuric acid in the quantitative determination of hydric peroxide by the iodometric method, but he is incorrect in expressing that great excess as consisting of from one to five volumes of 1 : 3 acid.

In my paper* (p. 803), for the purpose of illustrating certain newly-ascertained facts, I used various quantities, but, as evidenced by the results, it was shown that full decomposition of the peroxide was obtained in a few minutes in those cases where half a volume of the dilute acid was used. I repeat here, what I also then stated, viz., that I have made hundreds of determinations —I might say thousands without exaggeration,— by this modified process, with ease and accuracy.*

However, Dr. Schöne says the process is inaccurate, because Bunsen has shown certain results to accrue from the admixture of aqueous solutions of hydriodic and sulphuric acids of given strength (and under certain conditions), and because of the action of oxygen upon hydriodic acid. He also says I "should have at least determined precisely the peroxide of hydrogen in the trial solutions by a more trustworthy method."

As regards the first two objections I shall now show, by the description of further experiments, that they are of no validity; and as regards the third objection I beg to make reference to p. 807 (my paper), where the concordant results of determining the peroxide by three distinct methods are given. But even as regards this point I now adduce further evidence.

A solution of peroxide of hydrogen was prepared, and titrated with permanganate of potassium in the ordinary way:—

(A.) 20 c.c. H_2O_2 solution required 4·2 c.c. $KMnO_4$.
(B.) 20 c.c. H_2O_2 ,, ,, 4·2 c.c. ,,
of which 10 c.c. = 8·1 c.c. $Na_2S_2O_3$ N/10 solution.

Of this same solution of peroxide 5 portions of 20 c.c. each were placed in as many flasks, and acidified with, respectively, 5, 10, 20, 40, and 60 c.c. dilute (1 : 3) sulphuric acid. Potassium iodide in crystals was then added to each, and after standing five minutes the iodine was estimated by titration with decinormal thiosulphate in the usual way.

A required 3·5 c.c. $Na_2S_2O_3$.
B ,, 3·5 ,, ,,
C ,, 3·5 ,, ,,
D ,, 3·6 ,, ,,
E ,, 3·6 ,, ,,

In A and B the indications at the end of the titrations were as sharp as could be wished, but in C, D, and E they were not so sharp—an effect which is perhaps connected with some action of the large amounts of acid present upon the starch.

Now 3·5 c.c. $Na_2S_2O_3$ = 4·3 c.c. $KMnO_4$, against 4·2 c.c. $KMnO_4$ as required by titration with that reagent of the strength in question.

It should be clearly understood that I do not by any means recommend the use of such large quantities of acid as were employed in C, D, and E. Here they were used to support my statement that the objections urged by Dr. Schöne will not bear investigation, and this I submit they clearly show. At the same time, the results obtained indicate as close an agreement between the two methods employed as can be wished for in laboratory practice.

In another experiment, a mixture of 20 c.c. of the peroxide, with 5 c.c. of the acid and excess of KI, was allowed to stand exposed to the air for forty minutes, after which, on titration, the iodine set free required 3·5 c.c. N/10 hyposulphite, proving (if my former paper lacked proof) that the whole of the peroxide is decomposed within the first five minutes, working under the observed conditions, and that the oxygen of the air exercised no disturbing influence.

Again, a fresh solution of peroxide of hydrogen was prepared, of which 5 c.c. required 10·4 c.c. of the standard solution of permanganate.

(A.) 5 c.c., with 5 c.c. of 1 : 3 H_2SO_4 and KI crystals, set free iodine in five minutes = 8·2 c.c. N/10 $Na_2S_2O_3$.
(B.) 5 c.c. in this control experiment liberated iodine in five minutes = 8·2 c.c. N/10 $Na_2S_2O_3$.

In both cases the decomposition was complete.

---

* *Journ. Chem. Soc.*, 1880 (pp. 792—807).

* It should have been stated in my original paper that, when solutions of the peroxide are above 2-volume strength, I always dilute them before conducting the process.—C. T. K.

Now 8·2 c.c. $Na_2S_2O_3$ = 10·12 c.c. $KMnO_4$. Thus, the two methods again show as good an agreement in results as can be wished for.

Further, these results, together with those I have previously published, prove that, working with ordinary solutions of hydric peroxide, accurate determinations can be most easily effected with the iodometric method modified as set forth, viz., by the use of a reasonably large excess of dilute sulphuric acid,—avoiding such a ridiculously great excess as was employed by Dr. Schöne in two experiments, in which he also used an extremely attenuated solution of hydric peroxide.

The hydric peroxide concerned in most of my experiments* has been obtained either by the atmospheric oxidation of turpentine over water (in which case the permanganate method is out of the question), or of phosphorus, and its quantity has never been so small as to necessitate the development of the process I have used, so that it may apply to such infinitesimal quantities of H_2O_2 as have been observed by Dr. Schöne to be present in certain aqueous precipitates. Interesting as are his results in this direction, they have a special purport, and do not by their requirements in any way detract from the exactitude of my own observations.

Dr. Schöne also draws attention to the fact that, while my experiments confirm the observations recorded by him as to the action of pure neutral hydric peroxide upon potassic iodide, I have yet worded my conclusion respecting it somewhat inconsistently. He is quite right. Having regard to the very small amount of iodine liberated, I thought it might be passed over in summing up. But perhaps I ought not to have passed over it, although my experiments—which are described in detail, and reveal the truth—stand as a record of my meaning.

I now come to the last point at issue with Dr. Schöne, and that concerns his so-called colorimetric method for the estimation of peroxide of hydrogen in atmospheric deposits.

Neutral peroxide of hydrogen decomposes neutral potassic iodide, liberating oxygen gas, while the solution becomes alkaline, and a little iodine is liberated. For instance, to-day I took 100 c.c. of an aqueous solution of H_2O_2 capable of liberating iodine from an acid solution of KI equal to 164 c.c. N/10 $Na_2S_2O_3$. It was neutralised exactly with pure caustic soda, and then some crystals of KI were added, and the mixture was stirred. Oxygen was liberated in abundance, and the solution became alkaline, while iodine was set free. After half an hour the iodine required 3·6 c.c. of the standard thiosulphate. Now this iodine is set free by one of four reactions, supposed by Dr. Schöne to represent the whole truth. They are respectively represented by—

$$\begin{array}{llll}
\text{(A.)} & 2KI + 2H_2O & = 2KHO & + 2HI. \\
\text{(B.)} & H_2O_2 + 2KHO & = K_2O_2 & + 2H_2O. \\
\text{(C.)} & 2HI + H_2O_2 & = I_2 & + 2H_2O. \\
\text{(D.)} & K_2O_2 + I_2 & = 2KI & + O_2.
\end{array}$$

In my Report to the Chemical Society I wrote in a footnote "I cannot understand how he (Dr. Schöne) can advocate the use of this system of changes for determining atmospheric H_2O_2." I could not understand it because I was not clear that the amount of iodine liberated was a constant quantity, for it seems to be upon this supposition that Dr. Schöne bases his colorimetric method. I cannot understand it now because my doubts are, if anything, intensified by Dr. Schöne's admitted knowledge of the fact that—as he points out in his criticism of my work—"iodide of hydrogen is decomposed by free oxygen, always to be found in the solutions of peroxide" (and, he might have added, even more abundant in common air). Do not these sources of error militate against the accuracy of his method, which may almost be said to be based upon the fact that oxygen decomposes hydriodic acid? and, if so, may not that error be most serious if the solution of peroxide of hydrogen requiring examination only contains from 0·08 to 1 m.grm. per litre? I fail to see how he can urge this action of oxygen upon hydriodic acid as an objection to the process used by me, remembering that the reaction is $2KI + H_2SO_4 + H_2O_2 = K_2SO_4 + 2H_2O + I_2$.

I might add that, brief as is the abstract of Dr. Schöne's paper (*Annalen*, 195, p. 228), given on page 353 of the *Journal of the Chemical Society* for 1880 (Abstracts), there is a good and clear account of his colorimetric method given on page 743 of the same volume.

In conclusion, without desiring to prejudge the questions still at issue between Dr. Schöne and myself, I submit that this communication is a complete answer to the various objections he has urged against my Report on the Atmospheric Oxidation of Phosphorus.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Anniversary Meeting, March 30th, 1881.

Prof. H. E. Roscoe, President, in the Chair.

The President gave his annual address on the general condition of the Society. At no period in its history has the Society been in such a flourishing condition. The number of Fellows (1096) is the largest ever recorded. The papers read have increased both in number and importance, whilst the attendance and interest displayed at the meetings have at all events not diminished. The income has also increased, being £2916 as against £2719, the income of the preceding year. The number of papers read (113) has precluded the necessity of having lectures during the past season. The *Journal* still upholds its character for accuracy and usefulness. Many additions have been made to the Library; duplicate sets of some periodicals have been purchased. The books have been re-arranged, and are now classified according to subjects. Two card catalogues have been prepared; one arranged according to the authors' names, the other according to subjects.

The Research Fund, founded in 1876 by the donation of £1000 from Dr. Longstaff, now amounts to £4427. The City Companies have materially aided the foundation of this fund. Up to the present time thirty-seven grants have been made in sums varying from £100 to £5, and amounting in all to £1021.

The President then briefly alluded to the more important discoveries in chemical science during the past year. The observed alteration in the density of chlorine has been admitted by Victor Meyer to be due to some unexplained error; whilst the well-established fact of the diminution in density of the vapour of iodine at a white-heat can be explained by the dissociation of the molecules of that element. The solar and stellar evidence of the question of the decomposition of metals is being accumulated by Mr. Lockyer, but as yet has not assumed a sufficiently cogent form to enforce its general acceptance by chemists,—perhaps because the nature of the proof is not one with which they are familiar. The researches of Capt. Abney in conjunction with Col. Festing have been continued with conspicuous success. By photographing the absorption spectra of organic compounds in the infra red part of the spectrum they have accomplished for organic metals what ordinary high temperature spectrum analysis does for the inorganic metals. In these invisible portions of the spectrum are characteristic bands and lines for each organic radical, so that at a glance these photographs decide whether or not ethyl, methyl, &c., are present, just as a glance at the luminous portion of the spectrum satisfies us as to the presence of calcium, sodium, &c.: an investigation of greater importance to chemistry has seldom, if ever, been communicated to the

---

* In the experiments herein recited peroxide of hydrogen obtained in the ordinary way has been, of course, employed.

Society. An equally important confirmation of certain fundamental views of modern chemistry has been obtained by Helmholtz from a discussion of electro-phenomena: an account of these will be given at the forthcoming Faraday lecture. During the past twelve months not only has Baeyer succeeded in producing indigo artificially, but its manufacture on a commercial scale has been undertaken by competent hands. The first point of departure was cinnamic acid; the last link in the chain ortho-nitro-phenyl-propiolic acid, from an alkaline solution of which pure indigo-blue separates out on heating with grape-sugar. The theoretical yield of indigo is 68 per cent; 40 per cent has been obtained. Kolbe's idea, that the four combining units of each carbon atom are not of equal volume, was apparently verified by Schreiner's researches on the methyl-ethyl carbonic ethers. Geuther and Roese have, however, obtained results which flatly contradict those of Schreiner. Various new and rare metals have been prepared by Marignac, Nilson, Clève, &c.

The Society has lost by death two foreign members—Prof. Heintz, of Halle, and Prof. Mulder, of Amsterdam; and ten Fellows—Sir B. C. Brodie, Dr. Stenhouse, Prof. W. Hallows Miller, Messrs. J. Tennant, W. W. Stoddart, W. Arnot, A. C. Bruce, T. Eltoft, R. Johnson, and the Rev. D. W. Ladley.

The President then presented the Longstaff Medal to Prof. Thorpe, of the Yorkshire College, as the Fellow who, in the opinion of the Council, had done the most to promote chemical science by research during the past three years. The medal is of bronze; on one side is a very successful portrait of Dr. Longstaff. The medallion portrait is by Mr. A. Bruce Joy, the dies by Wyon, and the medal was struck at the Mint: it is accompanied by a purse of £20.

Dr. Longstaff rose to propose a vote of thanks to the President for his report, and to move its adoption. He said that it was a source of great gratification to him to be present at the presentation of the first Longstaff medal. He traced back his love of Science to the perusal of three books when a schoolboy—Joyce's "Scientific Dialogues," Blair's "Primer of Chemistry," and "The Life of Dr. Franklin." His researches had been principally confined to the application of chemistry to manufacturing purposes, but he hoped by his share in promoting the Research Fund that he had contributed something toward the advancement of scientific research. He trusted that the Research Fund would be still more successful, and that more persons who had benefitted by the application of discoveries in chemistry to manufactures would come forward and contribute.

Mr. Carteighe, in seconding Dr. Longstaff, referred to the debt which the Society owed to the President for his very regular attendance.

The President, in returning thanks, said that no apology was needed from Dr. Longstaff. He had originated the Research Fund, and had thus done a very good work for the progress of Science.

The Treasurer, Dr. Russell, then read his Report. The principal items are as follow:—Receipts by subscriptions, £2287; sale of *Journal* and Index, £323; dividends, £223. Expenses: *Journal*, £1688; library, £441; house expenses, £176; collector's commission, £114. The total income is about £2900; the expenditure £2600. The assets amount to £8193.

The Treasurer congratulated the Society on its very very flourishing financial condition, and pointed out specially the increase in the subscriptions and in the sale of the *Journal*.

The Treasurer then gave an account of the Research Fund, the principal items of which are given in the President's Address.

The Auditors then presented their Report, and various votes of thanks were passed. The Society then ballotted for the Officers and Council for the ensuing year. The Scrutators, Dr. Japp and Mr. J. Spiller, declared the following to have been duly elected:—

President—H. E. Roscoe.

Vice-Presidents—F. A. Abel, Warren De La Rue, E. Frankland, J. H. Gladstone, A. W. Hofmann, W. Odling, Lyon Playfair, A. W. Williamson, A. Crum Brown, J. Dewar, J. H. Gilbert, A. V. Harcourt, J. E. Reynolds, J. Young.

Secretaries—W. H. Perkin, H. E. Armstrong.

Foreign Secretary—Hugo Müller.

Treasurer—W. J. Russell.

Council—F. D. Brown, M. Carteighe, H. McLeod, G. H. Makins, E. J. Mills, W. C. Roberts, C. Schorlemmer, J. M. Thomson, C. M. Tidy, W. Thorp, T. E. Thorpe, R. Warington.

PHYSICAL SOCIETY.

Saturday, March 26, 1881.

Prof. Fuller in the Chair.

New Member, Mr. Lewis Wright, author and editor.

Dr. James Moser read a paper on "*Electrostatic Induction, especially relating to the Branching of the Induction in the Differential Inductometer and in the Electrophorus.*" The author's experiments bore out the hypothesis of induction as enunciated by Faraday.

Prof. Ayrton suggested the importance of adding guard-rings to the small plates of the five-plate inductometer or balance, since without these mathematical calculations could not be accurately applied, and the experimental determination of specific inductive capacity would be doubtful.

Dr. Moser pointed out that though the theory was not absolutely correct, it lay with the experimenter to get results very approximately correct.

Prof. Reinold, one of the Secretaries of the Society, read a paper, by himself and Prof. Rückert, "*On the Electrical Resistance of Liquid Films with a Revision of Newton's Scale of Colours.*" The experiments were in continuation of those published by the authors in 1877. Their object was to determine whether a film thinning under the action of gravity gave any evidence, by change in its specific resistance, of an approach to a thickness equal to twice the radius of the molecular attraction, and also to devise a method of finding the amount of water which might be absorbed by or evaporated from it. The thickness of the films was determined from their colour by means of two beams reflected from different mirrors on them. Newton's scale of colours was revised by observations on Newton's rings, and partly by more than two thousand observations on the rings themselves. The thicknesses determined by direct observations on Newton's rings and those in the corrected table rarely differ by 1 per cent, while Newton's scale in parts differs from both by as much as 10 per cent of the thickness. The films were formed from a solution of oleate of soda in glycerin, with a little nitrate of potash added to increase their electric conductivity. They were blown in a glass case from which the outer air could be excluded. Precautions were taken to keep the air in contact with the films inside the case at a proper humidity. These consisted in placing disks containing the solution at the bottom of the case, and suspending within it sheets of blotting-paper, the lower edges of which were dipped into the liquid. A hair hygrometer indicated changes in the humidity of the interior. The resistance of the films was measured by piercing them with gold wires, which were connected with the electrodes of a quadrant electrometer. The resistance of the film between the needles was calculated by comparing the deflection caused by the difference of potential of the two wires when a current was passing through the film with that produced by the difference of potential above and below a known resistance placed in the same circuit. The specific resistance of the liquid from which the films were formed was measured by a method identical in principle with the above. The liquid was contained in a glass tube with turned-up ends. Platinum wires were cemented into small holes drilled in the straight part of the tube, and their difference of potential compared with that of two points in the same circuit separated by a known resistance. This method has the great advantage of getting rid of any difficulties connected with polarisation. Test experiments on sulphuric acid proved the method to give results agreeing with those of Kohlrausch, who employed alternating currents and Wheatstone's bridge. The results of the experiments may be summed up as follows:—It is difficult to form a soap film under conditions precluding a slight evaporation or absorption of water, but the more nearly these conditions are attained the more closely does the specific resistance of the film agree with that of the liquid in mass. The films observed under the most favourable conditions obeyed Ohm's law with great accuracy, and much better than the others. The films indicate no approach to a thickness equal to the diameter of molecular attraction. A soap film may even in an enclosed space readily loose 23 out of 57·7 volumes of water contained in every 100 volumes of the solution, when special precautions are not taken to maintain the surrounding space in a constant hygrometric condition.

Prof. Ayrton suggested that in measuring the liquids and film the distance between the electrodes should be varied.

Prof. Guthrie pointed out that the results of Prof. Reinold and Kohlrausch agreed with his own in showing that the conductivity of liquids obeyed Ohm's law.

THE SOCIETY OF CHEMICAL INDUSTRY.

On Monday afternoon, 4th inst., the meeting referred to in our last issue was held in the Lecture Room of the Chemical Society, Burlington House. There was a very considerable attendance which included many Practical Chemists and Chemical Engineers of note, among whom were Professors Abel and Armstrong; Drs. Hewitt, Longstaff, and Russell; Messrs. Lowthian Bell, Alexander Chance, Carey Howard, Hermann, Gossage, Kingzett, Ludwig Mond, J. Spiller, and many others.

Professor Roscoe took the chair, and after some explanatory remarks as to the probable great utility of a Society such as was proposed, moved a resolution to the effect—"That the Society of Chemical Industry be then and hereby established."

This was duly seconded after some remarks from Dr. Longstaff and Mr. Kingzett. The latter feared the probability of collision between the Institute of Chemistry and the proposed Society of Chemical Industry.

Professor Abel, the President of the Institute, took occasion to emphatically state his conviction that there would be no clashing of interests, nor any doubt that there was plenty of room for the work of such a Society.

Some discussion arose as to whether the name of the Society should be the "Society of Chemical Industry," or the "Society of Chemical Engineers." The latter name was very largely supported on the ground that most of the difficulties in the application of chemical science arose on the question of apparatus and physical condition involved. After considerable discussion it was resolved to call the Society "The Society of Chemical Industry."

The following gentlemen were elected the first council: —*President*—Professor Roscoe, F.R.S.; *Vice Presidents* —Prof. Abel, F.R.S., Prof. A. W. Williamson, F.R.S., Messrs. I. Lowthian Bell, F.R.S., W. H. Perkin, F.R.S., Drs. C. W. Siemens, F.R.S., Angus Smith, F.R.S., Messrs. Jas. Young, F.R.S., F. H. Gossage, E. K. Muspratt, H. Lee Pattinson, W. Weldon, and Dr. Longstaff; *Committee*—Capt. Abney, F.R.S., Prof. Chas. Graham, Messrs. W. Crookes, F.R.S., P. Greiss, F.R.S., Dr. Hewitt, D. Howard, Jas. Mactear, H. Sprengel, H. Tate, P. Worsley, J. Spiller, and A. Chance; *Treasurer*—Mr. E. Rider Cook; *Secretaries*—Hon. Sec., Mr. G. E. Davis; Local and District Secs., Messrs. Eustace Carey, Ludwig Mond, and Thomas Tyrer.

The subscription was, after a vote, made for the first year one guinea.

The gentlemen present were made members of the Society without entrance fee, and a period of six months will be allowed during which any gentlemen considered eligible by the Council will be admitted as members.

Forms of application will be supplied by general and local Secretaries.

The address of Mr. Thomas Tyrer, the Secretary of the London District, is Garden Wharf, Battersea.

The usual vote of thanks to the Chairman concluded the business of the meeting.

Particulars as to the meetings, head quarters, &c., of the Society, will be published in due course.

CORRESPONDENCE.

BENZOL TESTING.

To the Editor of the Chemical News.

Sir,—As the writer of the letter from which has sprung the correspondence now appearing in your journal, and referring to benzol testing, may I ask your permission for the insertion of a second epistle touching the same subject. That it is not without interest may be inferred from the nature and extent of the transactions connected with it, and as stated by one of the writers in your last impression.

So far as one can gather from the various correspondents who have ventured their opinions, discrepancies in the operation of testing only occasionally occur; my own experience proves such as of daily and constant occurrence. I do not, however, think the question has been dealt with in the manner that might have been anticipated from some of the writers who appear to be analysts, and, as such, accustomed to seek out cause and effect altogether outside the "commercial element."

So far as my observation is concerned there are causes that tend to influence the results obtained under the time-honoured test by boiling-points, quite irrespective of the "commercial side," although unfortunately they may be made directly subservient to its bias and wishes. I refer to the possibility of obtaining varied results in the operation when conducted purely as a question of science, and with the most accurately adjusted instruments.

The method of examining and reporting by boiling-points has been pretty freely detailed in the recent correspondence, but some of the more important facts connected with it have been entirely omitted, intentionally or otherwise I am unable to say.

My original question had direct reference to the matter of thermometers employed in registering the operation, and as conducted in accordance with the well-understood contract terms. As it is one that plays an important part in the system, it may not be uninteresting to afford some idea of the wide discrepancies that can occur in the absence of care in selecting appropriate instruments. So long as we are dealing with fluids of constant or nearly constant boiling-points, thermometers of different forms and dimensions will, if accurately constructed, register alike; but in the case of complex liquids, such as commercial benzol, containing hydrocarbons of very unequal boiling-points and densities, the case becomes altogether different. Such a fluid contains true benzol, boiling at 81° to 82° C. with a sp. gr. of 0·885. Toluol, boiling at 111° C., sp. gr. 0·871. Xylol, boiling at 136° to 138° C., sp. gr. 0·868; and in many cases even higher homologues, associated with bodies of a different character. From one class of tars, compounds are introduced boiling as low as 20° C., with gravities ranging from 0·900 to 1·000, such as the alliol of Mansfield; bisulphide of carbon with other sulphur compounds are also frequently present to the extent of 2 to 4 per cent, whilst from another class, usually north country, we meet with products allied to the petroleum series boiling low with contra low gravities (under 0·850).

Now, a glance at these facts, and which are tolerably well known to tar distillers, notwithstanding the ignorance with which they are accredited, at once suggests varied conditions in the rate of boiling and distilling. During the interval in which the first 20 to 30 per cent passes over the light boiling compounds that may be present are escaping and condensing with very unequal ratio, and may to those unacquainted with the fact give rise to the most perplexing anomalies, even the shape and dimensions of the distilling vessel employed materially influences the result. Let any person accustomed to the test, and honestly seeking facts outside the "commercial element" and its interests, provide himself with the prescribed:—6 or 8 ounce retort and condensor, measure into the same his 100 c.c. of the benzol to be tested, say commercial 90 per cent, and having inserted the thermometer at the orthodox distance of ⅜ of an inch from the bottom, proceed to distil, carefully observing the usual, although very ambiguous, conditions laid down as regards drops and rate of running. The first fact noticeable will be that "different thermometers," as originally stated, "do not register the same and exact quantity of fluid over at given temperatures." It is at and up to the temperature of 85° C. that the great departure is met with, and during which the light boiling and highly volatile fluids are doing their utmost to escape from the retort. Beyond this degree each and all, if correct, will indicate alike. Instruments with mercury bulbs, differing considerably in size, mercurial columns varying in length, are each, in their way, elements of disturbing cause, and give rise to errors of some magnitude. I have seen a couple of instruments, equal as regards dimensions of bulb and capillary bore, but differing in length of column and by a space of 6 inches in the marking for 100° C., record wide variations. Employing these thermometers respectively on a given sample of 90 per cent benzol, I have witnessed 23 and 33 per cent obtained at pleasure, and for any number of repetitions at the 85° point, the rate of distillation in all cases being rigidly the same. Now, as this happens to be a critical point in forming an estimate on a given sample of such percentage, and may throw discredit on the same, or even condemn it, the fact is not without significance, and is ominously suggestive of the "commercial element" darkly hinted at by one of your correspondents, from my point of view, the possibility of buyers' and sellers' thermometers.

Some exception may be taken to the selection of high-quality benzol, although I think one of your writers has stated that "90 per cents are unaffected by the usual disturbing causes." I can only say this is not my experience, and I have further witnessed the more commonly-met with 50 per cent material show 47 only with a delicate short-column instrument, and 52 with a second, differing in the length of its marking by some six inches; after passing the division for 100° C. and onwards to 120°, both instruments indicate alike, showing that in this example, as with the other, the light boiling substances exist as disturbing causes. In the one case the mercury rises before the benzol has really had time to distil, in the other the action is slower, and consequently equalised.

Much has been said regarding the utility and value of the method so long followed in benzol testing, and there are many who think it so simple and perfect that it is incapable of improvement. I, for one, have my own views, and may at a future time ask your kind permission for the insertion of results obtained under a line of work conducted at my own wish and suggestion.

Benzol, toluol, and xylol are now recognised products in active demand, not in admixture only, but as pure substances, and I am at a loss to understand why the manufacturer should not be paid for such on the basis of their respective values, and in the same manner as with his anthracene.

A Country Tar Distiller.

BENZOL TESTING.

To the Editor of the Chemical News.

Sir,—When I wrote you my letter (Chemical News, vol. xliii., p. 115), I had unfortunately not read Mr. Staveley's letter in a previous number, otherwise, in deference to his opinions, I should probably not have called the process he defends a stupid one. I must say, however, that if I wished to prove to anyone that the process is anything but satisfactory, and that the term which I used was a justifiable one, I could not do better than refer him to Mr. Staveley's defence of it (page 129). It is admitted that the object of the process is to find the percentage of distillate which comes off, from any sample of benzol, at a given temperature—say 100° C. Mr. Staveley says that he distilled a sample of benzol, and did not allow the temperature to rise above 97° C., and he obtained 37 per cent of distillate, which even then had not ceased to come over; *but*, he says, this sample of benzol only contained 31 per cent of benzol distilling at 100° C. Why does he say so? Because he finds that percentage by his own process. This kind of reasoning reminds one of a man who assumes his watch to keep perfect time, so that if the earth made its complete revolution in twenty-five hours by his watch, that would prove that the earth had been an hour too long on its journey. I do not, however, condemn the process because it does not estimate accurately that which it purports to estimate, because such a process may be justified on the plea that it gives the same results in the hands of any one testing the same sample. Now let us see whether this is the case. I again refer to Mr. Staveley's letter. He says, in effect—I taught a certain chemist how to make the test, and he went away charmed with its simplicity, and repeated it in his own laboratory. Did his result agree with that which Mr. Staveley obtained? No, says Mr. Staveley, it did not. Well, one would naturally say, With such a simple process, carried out in the way so graphically described by Mr. Staveley, that the difference would be trifling. Not at all, is the reply; the difference amounted to between 20 and 30 per cent; or, as Mr. Staveley more pointedly puts it, the chemist he instructed "was wrong" to that extent. Now what is the cause of this extraordinary difference? Probably the unfortunate chemist had not attended to all the points which were necessary to obtain a result precisely similar to the one Mr. Staveley obtained; in other words, "the correct results." Perhaps the capacity of his retort was greater or less than that used by Mr. Staveley; perhaps the glass of the retort was too thick or too thin; the flame used too big or too small; the condenser too long or not long enough. All these things, I understand from Mr. Staveley's letter, make a difference; and in this Mr. Bettel, another of your correspondents on the same subject, confirms him. Mr. Bettel also resents the insult which I offered the process, and he also defends the method, only he says in effect, he doesn't use it. He does not put the flame directly to the bottom of the retort in accordance with the details of the process printed on the contract note to which I referred. He knows better than that, and has a method of his own for heating with hot air. As regards my question about placing the thermometer three-eighths of an inch from the bottom of the retort, I said in effect, if it be necessary to stipulate for that exact distance, why not stipulate also for the length of the bulb of the thermometer? Mr. Staveley's answer is conclusive: he says such differences at three-eighths of an inch and 1 inch in thermometer bulbs do not exist. In reply to that I may say I have a number of ordinary thermometers is use in my laboratory, the bulbs of which vary in length from three-eighths to one-and-a-half inches.

By assertions similar to that about thermometer bulbs does Mr. Staveley dispose of your correspondent "J. D.," who ventured to make a few remarks about the effects of barometric pressure on the percentage of benzol distillate. "J. D." said he had made accurate observations on this matter. Mr. Staveley does not say he has done so, yet he ventures not only to contradict " J. D.," but to do so in a jocular manner.

The process which I suggested had for its aim the application of a fixed degree of heat, which cannot be obtained by two persons working with naked lamps, and if the only objection Mr. Staveley has to the process I suggested be the length of time required for the distillate to come over, let him add some common salt to the water, and he will find he can not only distil as quickly as he does by his present arrangement, but that if he teaches anyone how to work such a process, he may rely upon the results obtained by himself and his pupil not being very different. If a solution of salt be objected to, then the same apparatus, used as an air-bath, with a mercurial arrangement for regulating the temperature may be employed. At all events, I think Mr. Staveley has clearly proved in his last letter that a new process which would give reliable results in the hands of anyone is advisable, if not absolutely necessary.—I am, &c.,

William Thomson.

Royal Institution, Manchester,
March 29, 1881.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, l'Académie des Sciences. No. 10, March 7, 1881.

Reciprocal Displacements of the Hydracids.—M. Berthelot.—The action of the hydracids upon the salts formed by the halogens is in general the inverse of that of the elements themselves. Thus hydriodic acid expels hydrochloric acid from the metallic chlorides and hydrobromic acid from the bromides, whilst hydrobromic acid also liberates hydrochloric acid from the chlorides. The chlorides in general are decomposed by hydrobromic acid, and this decomposition preponderates according to the thermic value of the principal action. But the bromides may also be decomposed, though less readily, by hydrochloric acid. This inverse action previously pointed out by M. Hautefeuille in the salts of silver at a red heat, and by the author in the moist way, has lately been observed anew by M. Potilizine, but it is in no way contrary to thermo-chemical principles. It results from the existence of secondary compounds, partially dissociated, which intervene with their peculiar heat of formation. The theory of these reciprocal actions and equilibria is always the same. In every case we have to do with a principal reaction, foreseen by the thermic theory, and a perturbation equally foreseen by the same theory, of which it is a necessary confirmation.

Presence of Trichinæ in Pork Imported from America.—M. Bouley.—The author considers that there is little danger of trichinosis in France, as the meat is never eaten raw or imperfectly cooked.

Presence of Alcohol in the Soil, the Water, and the Atmosphere.—A. Muntz.—The author has previously shown that it is possible to detect exceedingly slight traces of alcohol by converting it into iodoform. On concentrating the alcohol in a small volume of water by means of fractionated distillation, and using the microscope to verify the presence of iodoform, he was able to recognise with ease 1-300,000th of alcohol mixed with water. He has since improved the process so as to detect quantities even smaller than 1-1,000,000. During the last four years he has applied this method to river-, spring-, and sea-water, as well as to rain and snow. The results obtained leave no doubt of the presence of a neutral body, more volatile than water, and yielding iodoform. He thinks alcohol is the hydro-carburetted body present in the atmosphere, indicated by the researches of Boussingault and De Saussure. Soils rich in organic matter yield alcohol in such proportions that its essential properties may easily be verified.

Circular Double Refraction and the Normal Production of the three Systems of Fringes of the Circular Rays.—M. Crouillebois.—The author has previously (*Comptes Rendus*, Feb. 7, 1881) described a method of obtaining simultaneously three normal systems of fringes of the elliptical rays. He now points out a procedure for obtaining the same result for the three systems of fringes of the circular rays.

Widening of the Rays of Hydrogen.—C. Fievez.—The nebulous expansion of the spectral rays of hydrogen, noticed on increasing the pressure of this gas in a Geissler tube, is still ascribed to the influence of the pressure, though Dr. Schuster, Secchi, and others have shown that it is not possible to alter the pressure of a gas without at the same time affecting the resistance of the medium, and in consequence the temperature of the spark which traverses it. The author has undertaken to examine separately the influence of the different agents, temperature, pressure, direction of the current, &c., which have been suggested as contributing to produce this phenomenon. He finds that the widening of the hydrogen rays is correlative to the rise of temperature. We may affirm that the temperature of a celestial body is higher than that of another if its hydrogen rays are broader.

Certain Phenomena of Optics and of Vision.—M. Trève.—The author mentions the fact that the flame of a lamp appears brighter, and that a vertical shaft, a post, or mast is seen more distinctly through a vertical than through a horizontal slit, whilst a house, a landscape, or the disk of the sun or moon is perceived more clearly through a horizontal slit. He finds similar differences in photographs according as the light passes from the object to the plate through a vertical or a horizontal slit, and ascribes the results to the action of diffused light.

Solubility of Silver Chloride in Hydrochloric Acid in Presence of Water or of Sparingly Soluble Metallic Chlorides.—F. Ruyssen and E. Varenne.—For increasing volumes of a silver solution the solubility of the chloride remains constant. The addition of water though weakening the acid does not lessen the solubility of the chloride in the same proportion. The action of other metals is favourable to solution, but in a very slight degree.

Heats Liberated in the Combustion of Certain Substances of the Saturated Fatty Series.—W. Louguinine.—The author has studied from this point of view, capronic acid, caprylic alcohol, trimethyl-carbinol, and pinacone.

The Transformation of Glucose into Dextrine.—F. Musculus and A. Meyer.—The dextrine obtained is the γ of Musculus.

An Active Amylamine.—R. T. Plimpton.—The author has obtained an amine having rotatory power and possessing properties different from those of the inactive amylamine described in *Comptes Rendus*, xci., p. 433.

Active Propyl-glycol.—J. A. Le Bel.—The author has submitted propyl-glycol to fermentation, and has obtained a lævo-rotatory modification along with propionic and lactic acids.

No. 11, March 14, 1881.

This number contains the account of the annual public session of the Academy for the award of prizes.

Reimann's Färber Zeitung,
No. 42, 1880.

Dr. A. Müller-Jacobs describes his improvements in Turkey-red oils. He admits that the use of pyroterebic acid is not absolutely essential.

Two curious receipts are quoted from a journal not named:—"Juch's preparation of chrome-yellow. Boil 4 lbs. pure white lead with 1 lb. bichromate of potash and 10 lbs. water. A considerable quantity of ammoniacal gas is evolved." "Aniline-blue resists even the action of direct sunshine. It is obtained from a mixture of aniline hydrochlorate with liquid chlorous acid."

The editor inserts a communication from "Bollington, near Macclesfield, Nottingham," on the rubbing off of vat-blue stockings.

No. 43, 1880.

The bicarbonate of soda prepared by the Solvay process contains from 2 to 3 per cent ammonia, and is therefore not suitable for pharmaceutical use, and for certain technological purposes.

The sulphuric anhydride of the Freiberg works is now in the market.

No. 44, 1880.

This number contains nothing of general interest.

No. 45, 1880.

The colouring-matters of wine are said to be identical with those of the bilberry.

No. 46, 1880.

In this number the chief article is a comparison of the respective advantages of zinc and of copperas for the prevention of boiler-incrustations.

No. 47, 1880.

This issue contains nothing of general interest.

Biedermann's Central-Blatt für Agrikultur-Chemie, August, 1880.

Conduction of Rain-water along the Trunks of Trees.—Dr. W. Riegler.—The quantity of water which finds its way to the ground in this manner is very considerable, but varies much according to the kind of the tree.

Influence of Hilling upon the Temperature and the Moisture of Arable Land.—Prof. E. Woolny.—Soil heaped up around plants has a higher average temperature than the level ground, but it becomes colder in the night. It dries more rapidly.

Manurial Inefficacy of Phosphoric Acid on the Experimental Field at Grignon.—Prof. Dehérain and Meyer.—The conclusions reached are that phosphates produced no effect on the experimental field at Grignon; that the soil contained a notable proportion of phosphates soluble in acetic acid. The question is raised whether such a soils hould receive further supplies of phosphoric acid.

Manurial Experiments with Sugar-Beets.—A. Dudouy.—The author concludes that potash has had an injurious effect, whilst phosphoric acid proved inactive.

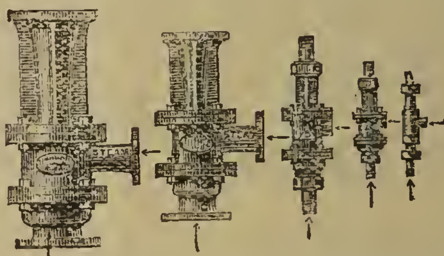
Experiments with Artificial Manures on Beets.—H. Pogge-Roggow.—The experiments were made with Peruvian guano and bone-dust. These manures increased the crop, but not to the extent sufficient to cover the extra cost of manuring.

MISCELLANEOUS.

Royal Institution of Great Britain.—Lecture Arrangements after Easter, 1881:—Lecture hour, 3 o'clock p.m. Prof. Dewar, M.A., F.R.S., Six Lectures on the Non-Metallic Elements; on Tuesdays, April 26 to May 31. Prof. Tyndall, D.C.L., F.R.S., Six Lectures on Paramagnetism and Diamagnetism; on Thursdays, April 28 to June 2. Prof. H. Morley, Three Lectures on Scotland's Part in English Literature; on Saturdays, April 30, May 7, 14: One Lecture on Thomas Carlyle; on Tuesday June 7. E. C. Turner, Esq., Lector at the University of St. Petersburg, Five Lectures on The Great Modern Writers of Russia; on Saturdays, May 21, 28, June 4, Thursday, June 9, and Saturday, June 11. The Friday Evening Meetings will be resumed on April 29th, at 8 p.m. Prof. J. S. Blackie, F.R.S.E., will give a Discourse on "The Language and Literature of the Scottish Highlands," at 9 p.m. Succeeding Discourses will probably be given by The Hon. G. C. Brodrick, Mr. Francis Galton, Mr. W. H. Pollock, Prof. H. E. Roscoe, Prof. W. G. Adams, and Prof. Dewar. To these meetings Members and their friends only are admitted.

MEETINGS FOR THE WEEK.

Monday, 11th.—Medical, 8.30.
—— Royal Geographical, 8.30.
Tuesday, 12th.—Civil Engineers, 8.
—— Medical and Chirurgical, 8.30.
Wednesday, 13th.—Microscopical, 8.
Thursday, 14th.—Mathematical, 8.



THE CHEMICAL NEWS.

Vol. XLIII. No. 1116.

ON THE
COEFFICIENTS OF EXPANSION OF THE DI-IODIDE OF LEAD, PbI_2, AND OF AN ALLOY OF IODIDE OF LEAD WITH IODIDE OF SILVER, $PbI_2.AgI$.*

By G. F. RODWELL, F.R.A.S., F.C.S., Science Master in Marlborough College.

The author having referred to his previous papers on the coefficients of the iodides of silver and mercury, and of certain chloro-bromiodides of silver, continues the same methods of determining the coefficients of the iodide of lead, and of an alloy of the iodides of lead and silver. Various alterations in the apparatus, which by the diminution of friction and other means have rendered it much more delicate than before, are described. The iodide of lead was found to possess three coefficients of expansion; the first for temperatures between 0° and 205° C.—

0·00008317 cubical expansion for 1° C.;

the second, a very high coefficient, between 205° C. and 253° C.—

0·0006378;

and the third, for temperatures between 253° C. and the fusing point—

0·000180.

The volumes at the different temperatures are given and tabulated, and the curve of expansion is plotted.

The lead silver iodide is next examined.

It contains in 100 parts:—

Iodide of lead ..	66·206	Lead ..	29·7449
Iodide of silver ..	33·794	Silver ..	15·5642
		Iodine ..	54·6909
	100·000		100·0000

Between 0° and 118° C., it slowly expands when heated with a cubical coefficient for 1° C. of

0·0000306.

Then for a few degrees (118 to 124° C.), it simply absorbs heat without contracting or expanding. On reaching a temperature of 124° C., the mass commences to contract on further heating, and this continues until a temperature of 139° C. is attained. Details of the contraction are given, and the curve of contraction is compared with that of the iodide of silver. Between 139° and 144° C., heat is again absorbed without change of volume; and above 144° C. the alloy expands somewhat rapidly, with a coefficient of

0·0001150.

The volumes at various temperatures between 0° and the fusing point are given, and are shown in a curve.

The following points are noted in regard to the alloy:—

1. It possesses a similar density at three different temperatures, as at 0° C., 130° C., and 282° C.

2. Although it contains only 33·794 per cent iodide of silver, it contracts as considerably *during heating* as the iodide of silver itself.

3. While the iodide of silver commences its contraction at 142° C., and finishes it at 145·5° C., the alloy commences to contract 18° C. lower (viz., at 124° C.), and finishes 6·5° C. lower (viz., at 139° F.).

4. The chloro-bromiodides of silver (*Proc. Roy. Soc.*, vol. 25, p. 292) also began to contract on heating (an effect which, of course, we must attribute solely to the presence of iodide of silver), at 124° C., but they finished at 133° C.

5. The harsh sounds emitted by the alloy during cooling, and the tremors simultaneously propagated through the mass, prove that violent molecular agitation is going on at such time as the iodide of silver is passing from the amorphous plastic condition to the brittle crystalline condition, within the mass of the iodide of lead.

6. The fusing-point of the alloy is 125° C. lower than that of the iodide of silver, which constitutes one-third of its weight, while it is only 19° C. higher than that of the iodide of lead, which constitutes two-thirds of its weight.

7. If the lowering of the fusing-point (also markedly apparent in the case of the chloro-bromiodides of silver) is due to the fact that similar particles of matter attract each other more powerfully than dissimilar, and hence, when the particles of two bodies are mutually diffused, the attraction becomes less, and the molecular motion is consequently more readily assimilated; the same cause may serve to explain the commencement of the phase of contraction on heating the alloy at a temperature of 18° C. lower than the substance to which it owes this property.

The lead silver iodide alloy is finally compared with a chloro-bromiodide of silver, which latter, although it contains 8 per cent more of iodide of silver than the lead-silver iodide alloy, undergoes a contraction on heating, which is more than twenty times less, although in both cases we must regard the effect as solely due to the iodide of silver.

ON THE
DETECTION OF ANILINE COLOURS IN RED WINES BY BROWNING'S MICRO-SPECTROSCOPE

By H. MACAGNO.

To a natural red wine diluted with one or two volumes of water, on adding a little of acetic ether, œnolin is slightly dissolved, and the supernatant fluid observed in a wedge-shaped cell with Browning's micro-spectroscope, no defined bands appear in the spectrum, but a very weak and hazy absorption from F to the end of violet takes place. This absorption does not interfere with characteristic bands of red or violet aniline colours, which absorb the rays of the complementary part of spectrum.

Fuchsin, safranin, and methyl-violet—commonly employed in adulteration of wines—are very readily soluble in acetic ether; so that by spectroscopical examination of this fluid, defined characteristic bands make their appearance in different parts of the spectrum.

Thus are seen the absorption-spectra of these substances in their pure state or mixed with one another. I indicate by < the rays (expressed by wave-length), between which bands are produced. The figures written at the side of vertical lines indicate two interposed rays, between which the greatest intensity of absorption takes place:—

Fuchsin.	Safranin.	Methyl-violet.
5775 <	5586 <	6100 <
5625 |	5460 |	6000 |
5490 |	5362 |	5892 |
5425 <	5175 <	5817 <

Fuchsin and Safranin.	Fuchsin and Methyl-violet.	Safranin and Methyl-violet.
5775 <	5586 <	5586 <
5625 |	6050 |	6050 |
5490 |	5892 |	5892 |
5290 <	5850 <	5850 <
	5667 <	5625 <
	5586 |	5586 |
	5525 |	5525 |
	5362 <	5400 <

---

* Abstract of a Paper read before the Royal Society, March 31, 1881.

The last two spectra give two bands almost equally placed, but they differ in their intensity. The lower band at the termination of the orange is darker and better defined than that in the green, when one observes a mixture of safranin and methyl-violet. The contrary takes place with fuchsin mixed with methyl-violet.

By this process the presence and quality of aniline colours can be detected and determined in a few minutes. Wines containing a very little quantity of these matters (0·005 grm. per litre), and so little that it certainly would be of no importance for commercial purposes, give very clean and characteristic spectral bands.

Agricultural Station of Palermo, Italy,
March, 1881.

ON THE ESTIMATION OF FAT IN MILK.

By WILLIAM M. HAMLET, F.C.S.,
Late Public Analyst for the Borough of King's Lynn.

The amount of fat present in milk is a factor so necessary to the solution of the problem of adulteration that a rapid and easy method of obtaining the result is an object of no small importance.

Since the early days of food-analysis a number of methods for the accomplishment of this purpose have from time to time been published: these may be classed as follows:—

I. Methods based upon the action of solvents on the undried sample.
II. The extraction of the fat from the dried milk in an open dish.
III. Extraction from the residue in closed vessels.

I.

The first method of this kind was proposed by Macnamara, in 1873, who sought to remove the fat from the milk in its original condition, but it never came into general use, being in practice found more complicated and less certain than the other methods. MM. Salleron, Vogel, Reischauer, and Marchand, each in turn improved upon the process, that of the latter chemist, although requiring specially-graduated apparatus, being on the whole the most successful. A full account of Marchand's process will be found in the excellent manual of Bolley and Kopp. But Méhu (*Journ. Pharm. et Chemie*, [4], xxix., 16 to 18), after having made an investigation as to its merits, pronounces it to be of value only as a preliminary test.

Lehmann (*Liebig's Annalen*, clxxxix., 358 to 367) allows the milk to flow over a porous tile resting on a vessel containing strong oil of vitriol, the fat being afterwards dissolved off by means of ether. I have never yet succeeded in finding a porous tile that would absorb the water present in milk to allow of anything like an approach to the real amount of fat.

Soxhlet (*Dingler's Polyt. Journ.*, ccxxxii., 461) recommends a method of extraction by ether after the milk has been partially dried by the aid of anhydrous sulphate of lime. He adds 20 grms. of dry gypsum to 10 c.c. of milk to hasten the desiccation and afterwards treats with ether. I cannot say I liked the process, and after three trials I found it afforded no better nor more rapid results than the well-known methods.*

II.

The best of the foregoing processes are not to be compared for general convenience with the class of methods I am about to describe, namely, those where the solids obtained on evaporating a given volume of the milk are digested with a solvent.

To Prof. Wanklyn we are indebted for the first systematic and reliable mode of analysing milk, the working of which is now so well known. In his book on "Milk Analysis," pp. 20 and 21, he recommends that the residue from 10 c.c. of milk, contained in a platinum dish of 40 c.c. capacity, should be first disintegrated with a few drops of alcohol, and then repeatedly boiled with ether, the ethereal extract being poured on to a small filter, dried, and finally weighed. Prof. Church, in commenting upon this process (*Laboratory Guide*, p. 219), very tersely says: "No one who has tried the method here recommended would adopt so clumsy, dangerous, and ineffective a plan." In justice, however, to the author of the process, it should be known that with a desire to make the method as practicable as possible Prof. Wanklyn advised certain precautions to be taken. In the Chemical News, vol. xxix., p. 3, he says:—"The operations are, first of all, the drying up of a small quantity of milk, and afterwards the boiling of the residue with ether; and a vessel, which is alternately an evaporating basin and a flask, is exactly that which is called for. These conditions are fulfilled as follows:—A thin platinum dish capable of holding 50 c.c, is employed, and in it the portion of milk (5 or 10 c.c. accurately measured) is evaporated to dryness. The dish during this evaporation is heated in the water-bath, which consists simply of a beaker half-filled with water, which is boiled over a lamp. The milk, as it is being evaporated, may be stirred with a small glass rod or small platinum spatula. The milk residue, having been obtained in a state of tolerable dryness, is covered with 20 or 30 c.c. of ether, and a *small inverted funnel* is fitted moderately tightly into the platinum dish, which is thereby converted into a flask. The further details are obvious. By the adoption of this apparatus the determination of fat in milk becomes perfectly easy."

Wynter-Blyth ("Manual of Practical Chemistry," p. 46) advises the same precautions to be taken, with the additional improvement, however, of a Liebig's condenser. By such means the process is much improved, but those who are called upon to make frequent analyses of milk will be inclined to agree with the observations of Prof. Church notwithstanding.

III.

The remedy proposed by Church was to scrape out the dry residue from the dish, reduce it to a powder, and transfer to the extraction-apparatus figured on p. 200 of his "Laboratory Guide."

I found, as a result of my own experience, that, however careful one might be, some loss inevitably occurs, owing to traces of the residue adhering to the dish. In order to avoid errors from this source I used to weigh the residue before going on with the extraction, and calculate the result upon the milk evaporated. Thus I obtained pretty good results, but with an extra expenditure of time and labour.

Of the many methods I have tried, and I believe they include nearly all that have been published, I find none so ready and at all times so effective as the one I will now describe.

The chief feature of this process consists in breaking or cutting up into small pieces the dish in which the milk has been evaporated. The dishes I employ are made of very thin blown glass, and measure 2¼ inches or 5·5 centimeter in diameter, and not more than ½ inch or 12 m.m. in depth. In default of these I have many times substituted common watch glasses 2 inches in diameter—the thinnest I could select. But a little dish made of thin copper or aluminium foil will answer equally well. The shreds and cuttings, or the broken pieces, if of glass, are simply transferred to the extractor, and the fat removed by any convenient solvent. I prefer to have the solids in a granulated condition, brought about either by stirring or by adding alcohol or acetic acid. Any of the various extraction-apparatus may be used. A most convenient one consists of an upright Liebig's condenser, to which is

---

* Since this paper was written a full account of Dr. Soxhlet's improved process has appeared (Chemical News, vol. xliii., p 101), which, up to the present moment, I have had no chance of trying. It certainly seems an advance upon his older method, and is made upon the milk direct and without previous evaporation.

attached a tube 6 inches or 15 centimetres long and ⅝ths to ¾ inch or 15 to 20 m.m. in diameter. At the upper end of the tube a funnel is fused on* having a diameter of 2½ inches or 6 centimetres for the purpose of transferring the solids quickly and without the slightest loss. The lower end of the extraction-tube is drawn out to a small bore, and receives a sound cork, previously boiled in water. To this is fitted a small flask of known weight.

The Process.—10 c.c. of the milk at 15·5° C. is accurately measured and allowed to run into one of the thin glass dishes previously described—a metallic foil or glass dish. These should have been previously laid dry upon the top of the steamer, and the milk poured in without having to remove the dish until the milk has evaporated to dryness. The residue, which will be dry in about an hour, is then placed in a 4½-inch shallow mortar, glazed on the inside and having a good lip. A clean linen cloth is placed over the pestle and mortar to prevent ejection of the pieces, and the dish is crushed up into pieces small enough to enter the tube. A few carefully-directed blows with the pestle will reduce the dish and residue to pieces about ¼ inch across without fear of the slightest loss. Of course if the dish be a metal one, a pair of scissors obviously replaces the mortar. Now lay a plug of cotton- or glass-wool in the lower part of the tube, and transfer the residue along with the bits of broken dish. Another plug of wool and the tube is packed and ready to be attached to the condenser by a cork. In four exhaustions every trace of fat is removed from the residue. My plan is now to attach the flask to another Liebig's condenser inclined at about the usual angle, and distil the ether off by means of a beakerful of hot water. By this means the same ether with trifling loss does over and over again. All that now remains is to warm gently on the water-bath, and then dry in the water-oven until constant, which may be done in two weighings with an interval of half an hour. The following examples show what may be expected of the process with ordinary care:—

A.—A sample of milk was employed, which yielded by Wanklyn's method 2·92 grms. of fat per 100 c.c. milk.

No. 1. ..	10 c.c.	gave	0·2990 grm.
No. 2. ..	,,	,,	0·2985 ,,
No. 3. ..	,,	,,	0·3001 ,,
No. 4. ..	,,	,,	0·2989 ,,

B.—A sample of watered milk, yielding only 1·88 grms. per 100 c.c. by Wanklyn's method.

No. 1. ..	10 c.c.	gave	0·1890 grm.
No. 2. ..	,,	,,	0·1895 ,,
No. 3. ..	,,	,,	0·1891 ,,
No. 4. ..	,,	,,	0·1897 ,,

The process is equally accurate with the residue obtained from even 5 c.c. of milk—the quantity originally suggested by Wanklyn.

The following were all dried in common watch-glasses—C.—

No. 1. ..	5 c.c.	gave	0·1144 grm.
No. 2. ..	,,	,,	0·1140 ,,
No. 3. ..	,,	,,	0·1146 ,,
No. 4. ..	,,	,,	0·1144 ,,
No. 5. ..	,,	,,	0·1139 ,,

10 c.c. of the same sample of milk employed in series C.—

No. 1. ..	10 c.c.	gave	0·2288 grm.
No. 2. ..	,,	,,	0·2287 ,,
No. 3. ..	,,	,,	0·2290 ,,

5 c.c. I find upon the whole the most convenient volume to work upon, and I need scarcely say that greater care must be observed in measuring such a small quantity or serious discrepancies are sure to follow. The delivery-volume of the pipette must be accurately ascertained at 15·5° C., and the milk *always measured at the same temperature.* Stale milk must be weighed, never measured.

With regard to the observation of Geber, who advises that the casein should be first precipitated before proceeding to estimate the fat, and to Ritthausen, who employs cupric acetate or sulphate for the same purpose, I may remark that these reagents, as well as acetic acid, make no perceptible difference in the results. Granulation or disintegration of the solids by alcohol or stirring with a little acetic acid appears to favour the action of the ether, but for all ordinary purposes the residue may be made to yield all its fat without disturbance of any kind. The process is well adapted for the estimation of small amounts of fat, and I employed it with the greatest success in the analysis of some chylous urine, where a very accurate estimation of the fat was necessary.

In conclusion I hope that in placing these observations before the readers of the Chemical News the above process will be found to fulfil those two most desirable conditions in the work of a chemist, namely, accuracy and despatch.

METHODS FOR JUDGING OF THE WHOLESOMENESS OF DRINKING WATER.*

By REUBEN HAINES.

Many years ago, the usual way to ascertain the wholesomeness of drinking water was to discover what mineral impurities were present. The water was therefore evaporated to dryness, and a more or less complete analysis was made of the solid mineral substance left, as is done with mineral-spring waters. Little attention was given to the organic matter, except when present in very large amounts, as in marsh water, &c. Occasionally, even now, we read of some one making tests for mineral impurities in a suspected well water, but omitting any test for the organic matter. Such analyses were exceedingly troublesome; and, after all, it is very doubtful whether they were of much value—in many cases perhaps of no value whatever, in ascertaining the wholesomeness of ordinary drinking water. Of course, the detection of iron and of sulphate of lime and magnesia, in this way, was of some importance, for waters containing considerable amounts of these substances should be considered unwholesome for daily use, in health. But we really have no reason at all for supposing that such mineral substances as silica, alumina, potash, and soda, as they occur in any but very rare cases, have any influence whatever on health. Moreover, waters which are free from much mineral salts may often be very unwholesome for other reasons not discoverable at all in this way. This sort of analysis has therefore been entirely discarded by chemists conversant with recent sanitary experience, except in selecting a new source of water supply for a city, which involves other than sanitary interest as well.

In the preceding lecture it was shown that by far the most important element in sanitary investigations of water is the organic matter contained in it, either in the form of minute suspended particles or in actual solution. It was shown that the purest rain and spring waters contain a minute amount of organic matter, but that rivers, streams, and shallow wells in populous districts, contain much larger proportions of it. It has long been known that waters, the sources of which originate in populous districts, were often the apparent cause of disease.

These facts have been for many years recognised by chemists, and it has therefore been their endeavour to devise methods for finding the exact amount and also the

---

* This is not absolutely essential, as the residue may be transferred in the same way that an ordinary combustion-tube is filled. But there is no room for doubt as to which is the best plan.

* Abstracts of lectures delivered before the Franklin Institute, December, 1880, in which additional original has beeen introduced. From the *Journal of the Franklin Institute*, February, 1881.

nature of this organic material. Let us now briefly review the advances which have been made in this direction.

The earliest method used for this purpose was what is known as the "ignition" process. It consisted in evaporating a measured quantity of water to dryness at a temperature which varied with different chemists, and weighing the residue. This residue was then exposed in a platinum dish to a sufficient heat to burn away all the organic matter. On cooling, the weight was again taken, and the difference was called organic matter. It was very simple, and easily performed, and was extensively practised. It has been shown, however, to give very erroneous results in a large number of cases, especially with hard waters and well waters containing considerable nitrate. There are numerous chemical objections to it which render it entirely fallacious, but it will not be proper on the present occasion to enter into much chemical detail. We may say, however, that any carbonates of lime, &c., will, by the heat necessary to burn away the organic matter, partially lose their carbonic acid, ammoniacal salts will be volatilised, nitrates will be converted into carbonates by the carbon of the organic matter, these and other salts will lose water of crystallisation, and if much chloride of sodium is present, in contact with carbon, hydrochloric acid will be volatilised, the fumes of which are often perceptible in thus treating the residue of a highly polluted water. Moreover, it is frequently difficult to get rid of the last traces of unconsumed carbon without raising the intensity of the heat so as to render the loss of mineral salts positively certain. In fact, we can never know what interchanges may take place among the materials of the residue when heated to faint redness. Various efforts were made to avoid this, or to replace the loss. Carbonate of soda was added during the first evaporation, but it has been shown that by this means a part of the organic matter was liable to be destroyed before the first weight was taken. Carbonate of ammonia, or carbonic acid water was added to the residue after being heated, so as to restore the lost carbonic acid, but while this confessedly replaces only a part of the loss, it has also been shown that the weight of the residue is frequently increased in a curious and irregular manner by this means, so as finally to become sometimes considerably greater than it was before being heated at all.

Prof. Wm. Ripley Nichols finds this method, with the employment of aqueous carbonic acid, of some utility for the relative comparison of the very soft waters of many New England streams. In these cases the loss appears to represent chiefly organic matter, and is recorded as "organic and volatile matter," which is the only accurate designation for it. But the results probably can never be, constantly, very exact, and no reliance should be placed upon them to the exclusion of other tests. In the case of the majority of well waters, Prof. Nichols considers this method valueless. It may frequently be useful, and as a qualitative test only, to heat the solid residue, and notice the odour, if any is given off. This will aid us in distinguishing animal from vegetable substances.

The unsatisfactory character of the "ignition" method led chemists to adopt what is known as the "permanganate" method. Of this there are numerous modifications, giving different results according to the practice of different chemists. They are all based on the same general principle, which is strikingly illustrated by the action of potassic permanganate on oxalic acid in solution. The magnificent colour of the permanganate almost instantly dissappears in a surprising manner. If we pour very rapidly, numerous bubbles of gas rise and burst at the surface, exactly as in a glass of soda water. Now, what happens here is, chemically, just as truly combustion as the burning of coal in a fire, only the oxidation takes place in water instead of air. The permanganate is rich in oxygen, which it gives up very readily, and this combines with the oxalic acid to form carbonic acid and water, just as the oxygen of the air unites with the burning coal to form the same substances. The oxalic acid is destroyed and the resulting carbonic acid gas passes off in small bubbles. The permanganate also is destroyed, as is shown by the disappearance of colour, and the hydrated oxide of manganese, which would otherwise settle in brown particles, is held in solution by sulphuric acid, a little of which was previously added, forming the colourless manganese sulphate.

Now oxalic acid is only one of the organic substances upon which potassic permanganate acts in the same way, in a greater or less degree. As long as there is organic substance in the liquid to be acted upon, the colour of the permanganate will be destroyed, although, in some cases, very slowly; but as soon as this organic substance is exhausted the pink colour will remain permanent in the liquid. We obtain in this way a sort of measure of the amount of organic substance. In the actual analysis the chemist takes a measured quantity of the sample of water and pours into it from a measuring-tube, called a burette, a solution of permanganate of known strength. This is a very imperfect description of the method, but it is sufficient for our pupose.

This method, with whatever modification it is used, does not really show how much organic matter is actually present, but only how much oxygen has been required by the substances which are capable of being oxidised in this way. German chemists are in the habit of reckoning five times the numbers obtained in the analysis as representing the total amount of "organischer substanz." This is, however, an arbitrary factor, and while it may have been tolerably accurate for some waters used as test analyses, we have no proof at all that the calculation would be accurate in all other cases, and it is hence reduced to a mere guess.

There are many objections to this method which show it to be very unreliable. Different substances are acted upon in very different degrees by permanganate, and upon some that must frequently occur in polluted water there is no action at all. Hence the method cannot by any means be relied upon to give the absolute amount of organic substance. If nitrous acid, ammonia, hydrogen sulphide, or protoxide of iron are present in the water they will affect the permananate in the same way as organic matter, and would be counted as such in the analysis. We must, therefore, find the amount of these substances in other ways and make a correction for them. It is also stated to be uncertain whether the action on ammonia is uniform, and if it is not, no accurate correction for the ammonia can be made. Dr. Frankland, while condemning this method as entirely unreliable for ascertaining the *quantity* of organic matter, admits that it may be a useful *qualitative* test. "Thus," he says, "if a clear and colourless water decolourises much of the permanganate solution the water ought to be rejected for domestic use, as being of doubtful quality." It has the advantage of being readily performed, as a qualitative test, in a short time, with few materials and no special apparatus, and is therefore useful on occasions when there is no opportunity for a regular analysis.

In the hands of any one chemist, its use as a quantitative method will, without doubt, give some valuable information as to the relative quality of different waters, if the test is always performed in the same manner. The degree of rapidity with which the oxidation takes place will probably give some idea as to the putrescible nature of the organic matter. It is thus that Dr. Tidy's periodical analyses of the metropolitan water of London, by the permanganate method, have not been without value.

In England and America both the methods I have described have been to a great extent abandoned, and two other methods have taken their place. These are Wanklyn's ammonia method, and Frankland's combustion method, which were devised and published at nearly the same time in 1867 and 1868. The Frankland process consists in evaporating a measured quantity of water to dryness and burning the residue in a combustion-tube on the same principle as that by which an organic analysis is made. The resulting gases instead of being immediately absorbed are measured in a delicate and complicated apparatus for gas analysis, and then separated by absorption. The gases resulting from the organic matter are chiefly carbonic acid and nitrogen, and are calculated as organic carbon and organic nitrogen. The gases are drawn out of the combustion-tube by means of a Sprengel vacuum pump, and upon the perfection of the vacuum produced depends, in part, the reliability of the results.

The Wanklyn method, which is much more generally practised, makes use of the potassic permanganate. A measured quantity of the water to be analysed is put into a glass retort, to which is attached a condenser. A little carbonate of soda is dropped in through the stoppered orifice in the retort, and the water is distilled rapidly until no more ammonia is given off, and condensed with the steam. The distilled water is collected in flat-bottomed test-tubes of perfectly colourless glass. This ammonia which is first distilled is called free ammonia. It is that which is present in the form of ammonia, either in the free state or in combination, in the water. A solution of potassic permanganate, with which a strong solution of caustic potash has been mixed, is now poured into the retort, and the distillation continued until no more ammonia is perceived in the distilled water. The ammonia now found in the distillate is called "albuminoid ammonia," and is that which results from the decomposition of nitrogenous organic matter by the action of the permanganate solution. Hence it represents that organic matter, and forms a relative, more or less definite, measure of it. It is upon this peculiar action of a boiling, strongly alkaline solution of potassic permanganate that the method of Wanklyn is founded. The delicacy of the method depends upon the sensitiveness of the Nessler test for ammonia, which is one of the most delicate colorimetric tests in the whole range of analytical chemistry, being capable of recognising easily one part of ammonia in ten million parts of water, and distinguishing differences of one-third of this amount.

Let us now consider some of the defects of these two methods of analysis and appreciate what may be really learned by their use.

In the first place, by neither of them can we, with certainty, estimate the exact amount of organic matter actually present in water. For this purpose there is no method known; nor can these methods enable us to identify and separate the different kinds of organic substances that may be present. In fact, we know almost nothing as to their nature, except that there is a general impression that much of this polluting material is probably of an albumenoid character.

Frankland's method endeavours to estimate the exact quantity of organic matter, but as will be seen by a candid examination of the essential defects of the process, there is at least a formidable array of probabilities against the possibility of its doing this.

Wanklyn, on the other hand, does not undertake to estimate the absolute quantity, but simply attempts to find a factor by which to make a tolerably accurate comparison of the relative purity or impurity of water. By this method we analyse a naturally good water, known beforehand to be wholesome by long experience and absence of any contaminating source, and the results obtained from this are then taken as a *standard* by which to compare other waters. The opinion is expressed by some chemists that this standard, although practically constant for any one locality, will be apt to vary considerably for different localities, even remote from the seaside.

In comparing the two methods we may say that both are philosophical in some points, and both unphilosophical in other ways.

That of Frankland seems theoretically better, because a combustion is made of the organic matter on precisely the same principle that is employed in the ultimate analysis of an organic compound. By this means the carbonaceous matter not nitrogenous is also estimated, which does not enter into the results of Wanklyn's method.

But Wanklyn's method is more philosophical, because it deals with the water itself, and not with merely the solid residue left after evaporating the water. We want to know what is contained in the water, or at least the properties of the water; but we do not necessarily need to to know what is in the residue, for it is at best only indirect evidence, and what is shown by it may be only partially true of the water from which the residue came.

The value of Frankland's process depends on the assumption that what is contained in the residue fairly represents what is contained in the water itself, deducting of course the nitrates, which must be got rid of in conducting this method. This is really an assumption which Frankland has never clearly proved to be a fact, and which Wanklyn and others, including German authorities, claim is a mistake. It has been shown by German chemists that an appreciable amount of organic matter is lost during the evaporation of the water, especially when originally volatile matter is present. Moreover, we have no knowledge as to whether volatile products may not be formed during the evaporation at the boiling temperature. Frankland endeavours to prevent the latter result by the addition of sulphurous acid, taking advantage of its antiseptic properties. This has, however, been shown to be quite objectionable, causing the inevitable loss of part of the organic matter through the formation of gradually concentrating sulphuric acid. It is claimed that the further addition of sodium sulphite will not sufficiently neutralise this acid; but whether this is correct or not may not have been proved. Several other technical objections* have been advanced against the method, which it will be unnecessary to quote here. Finally, the chances of error and the numerical corrections to be made are so numerous as to make this method quite complicated and difficult. It requires the chemist to be thoroughly skilled in the most delicate gas analysis, on account of the exceeding minuteness of the quantities to be measured, as compared with ordinary analysis. The apparatus is costly and fragile, and considerable time is required for each analysis. Skilful chemists might not consider some of these as really serious objections, but they will certainly prevent the general adoption of this method by City and State Boards of Health for sanitary purposes.

This method endeavours, also, to determine the character of the organic matter by the proportionate relation of the organic nitrogen to the organic carbon, this relation being found to be, by an average between wide limits, respectively, 1 : 11·9 for waters containing extract of peat, and 1 : 1·8 for sewage.

But Frankland has found that oxidation of peaty matter decreases the carbon, while oxidation of sewage decreases the organic nitrogen. "It is thus evident that the proportions of nitrogen to carbon in soluble vegetable and animal organic matters vary in opposite directions during oxidation—a fact which renders more difficult the decision as to whether the organic matter present in any given sample of water is of vegetable or animal origin."

Prof. Nichols quotes from Sander:† "Without a knowledge of the previous history of the water, the relative proportion (between carbon and nitrogen) is not available as a means of deciding as to the nature of the contamination; if, however, the previous history of a water is known, there is scarcely need of so particular an analysis in order to judge of its character."‡

It has been shown that in the case of very pure waters the experimental error may often be greater than the total amount of organic material to be estimated, and that in the case of waters containing readily decomposable nitrogenous organic matter, together with a large excess of nitrates, the accuracy of the results may be more or less vitiated by the efforts to get rid of the latter. Mr. Wigner

---

* *Vide Jour. Chem. Soc.*, Chemical News, &c.

† Prof. Nichols's paper in Buck's "Hygiene," vol. i., p. 303.

‡ "Handbuch der Offentlichen Gesundheitspflege," p. 230.

says that "supposing that the organic nitrogen yielded by the Frankland and Armstrong process were a positive quantity instead of a quantity needing a heavy correction for personal equation and for impurities in the chemicals used, yet the danger of error involved in the analysis, and the risk of contamination by atmospheric impurities, are in my opinion sufficient to prevent it from ever coming into general use; and unless generally used it is undesirable for reports which appeal to public sense and public understanding."[*]

(To be continued.)

LONDON WATER SUPPLY.

Report on the Composition and Quality of Daily Samples of the Water Supplied to London, from February 21st to March 19th, 1881.

By WILLIAM CROOKES, F.R.S.,
WILLIAM ODLING, M.B., F.R.S., F.R.C.P.,
Professor of Chemistry at the University of Oxford;
and C. MEYMOTT TIDY, M.B., F.C.S.,
Professor of Chemistry and of Forensic Medicine at the London Hospital; Medical Officer of Health for Islington

To the Right Honourable the President of the Local Government Board.

March 21, 1881.

Sir,—We submit to you the results of our examinations of the water supplied to the Metropolis for the month ending March 19th.

The circumstances under which the examinations have been made and the precautions taken to secure trustworthy results are similar to those we have described in our previous reports, but the samples have been collected from different localities.

It will be noticed that as regards turbidity and colour a great improvement has taken place in the Metropolitan waters since the date of our last report. The suspended matter has sunk to an insignificant amount, and in most cases is entirely absent.

For some time past we have been experimenting on methods of determining the colours of water, and we have this month adopted a process which, whilst it does not pretend to absolute accuracy, is a great improvement over the arbitrary "degrees of tint depth" by which the colour of water has hitherto been estimated. The process briefly is as follows:—

Two hollow wedges are filled one with a brown and the other with a blue solution,[†] and these are made to slide across each other in front of a circular aperture in a sheet of metal. In this way any desired combination of brown and blue can be produced. Each prism is graduated along its length from 1 to 40, the figures representing millimetres in thickness of the solution at that particular part of the prism.

On a level just below the prisms is a two-foot tube containing the water under examination, and having in front of it a circular aperture of the same size as the one in front of the prisms.

The stand supporting the prisms and tube is placed horizontally in front of a uniformly lighted window. The observer, standing a little distance off, sees two luminous disks, the lower one illuminated by light which has passed through two feet of the water, and the upper one illuminated by light which has passed through the respective thicknesses of the brown and blue solutions.

By sliding the prisms sideways one way or the other it is easy to imitate with considerable accuracy the depth and tint of the colour of the lower disk. A metal pointer affixed over the centre of the upper disk shows on the prism scales the number of millimetres in thickness through which the light has passed to produce a colour which corresponds to that of the water, and the results are recorded in the following way—Brown : Blue. Thus, "February 21st (New River), 20 : 21 means that on that date the colour of New River water seen through a two-foot tube was represented by 20 millimetres of brown and 21 millimetres of blue solution.

In Table I. we have recorded the analyses in detail of samples, one taken daily between February 22nd and March 19th. The purity of the water in respect of organic matter, has been determined by the Oxygen and the Combustion processes, and the results of our analyses by these methods are stated in columns XIV. to XVIII.

In Table II. is recorded the colour by the method above described, together with the clearness or turbidity of each sample. Of the 168 samples collected by us between the dates mentioned above, 144 were found "*clear*," 21 were noted as "*very slightly turbid*," and 3 as "*slightly turbid*."

Of the 24 samples supplied by the New River Company, the whole were clear, bright, and efficiently filtered.

Of the 24 samples from the mains of the East London Company, 5 were noted as "very slightly turbid." The remainder were bright, clear, and well filtered.

Of the 24 samples from the mains of the Chelsea Water Company, 1 was noted as "very slightly turbid." The remainder were bright, clear, and well filtered.

Of the 24 samples from the mains of the West Middlesex Company, 1 was noted as "very slightly turbid." The remainder were clear, bright, and well filtered.

Of the 24 samples from the mains of the Lambeth Water Company, 8 were noted as "very slightly turbid," and 3 as "slightly turbid." The remainder were clear, bright, and well filtered.

Of the 24 samples from the mains of the Grand Junction Company, 4 were noted as "very slightly turbid." The remainder were clear, bright, and well filtered.

Of the 24 samples from the mains of the Southwark and Vauxhall Company, 2 were noted as "very slightly turbid." The remainder were clear, bright, and efficiently filtered.

If a trace of suspended matter be noticeable, we record the water as "turbid." If on close scrutiny we are able to detect any suspended matter whatever, we call the water "very slightly turbid." A water is recorded as "slightly turbid" when we consider it to come between those two extremes.

In Table III. we have recorded the oxygen required to oxidise the organic matter, and the quantities of free oxygen in the whole of the samples collected.

We have already called attention to the great improvement that has taken place in the appearance of the Metropolitan waters since the date of our last report, and we have now to record our opinion that, taken as a whole, they leave nothing to be desired in respect of efficient filtration, wholesomeness, or complete aëration.—We remain, Sir, your faithful servants,

William Crookes,
William Odling,
C. Meymott Tidy.

Preparation of Glycolic Acid from Sugar.—H. Kiliani.—Levulose and dextrose in aqueous solution are oxidised by silver oxide to glycolic, oxalic, and carbonic acids, even at common temperatures. Cane-sugar is reduced with the aid of heat, but mere traces of glycolic acid are formed unless the sugar has been previously inverted.—*Liebig's Annalen.*

---

[*] *Sanitary Record*, October 19, 1877.

[†] The solutions are made in the following way:

Brown Solution.—Dissolve ferric chloride and cobalt chloride in distilled water in such proportion that one litre of the solution contains 0·7 grm. of metallic iron, and 0·3 grm of metallic cobalt. A very slight excess of free hydrochloric acid must also be present.

Blue Solution.—Dissolve 10 grms. of pure crystallised sulphate of copper in one litre of distilled water.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday April 7th, 1881.

Dr. Russell in the Chair.

The following certificates were read for the first time:—T. P. Venable, A. J. Shilton.

The Chairman then called on Mr. W. Jago to read a paper "*On the Organic Matter in Sea-water.*" On p. 133 of the "Sixth Report of the Rivers Commission" it is stated that the proportion of organic elements in sea-water varies between such wide limits in different samples as to suggest that much of the organic matter consists of living organisms, so minute and gelatinous as to pass readily through the best filters. At the suggestion of Dr. Frankland, the author has investigated this subject. The water was collected in mid-channel between Newhaven and Dieppe by the engineers of the London, Brighton, and South Coast Railway in stoppered glass carboys. The author has used the combustion method, the albumenoid ammonia, and in some cases the oxygen process of Prof. Tidy. To determine how the various methods of water-analysis were affected by a change of the organic matter from organic compounds in solution to organisms in suspension, some experiments were made with hay-infusion. The results confirm those of Kingzett (*Chem. Soc. Journ.*, 1880, 15), the oxygen required first rising and then diminishing. The author concludes that the organic matter of sea-water is much more capable of resisting oxidising agents than that present in ordinary fresh waters, and that the organic matter in sea-water is probably organised and alive. Several tables accompany the paper. The author promises some further work on the subject.

In answer to Mr. Piesse, the author stated that no determinations of phosphoric acid were made.

Mr. W. M. Hamlet then read a paper "*On the Action of Compounds Inimical to Bacteria Life.*" After criticising the experiments of Crace-Calvert (Chemical News, vol. xxii., p. 281), in which the solutions were exposed freely to the action of the air, and were in some cases even allowed to dry up, the author details his method of experimentation. Flasks similar to those of Pasteur ("Etudes sur la Bière," p. 81), holding about ½ litre, were used. The liquids employed were Pasteur's fluid with sugar, beef-tea, hay infusion, urine, brewers' wort, and extract of meat. Each flask was about half filled, and boiled for ten minutes, whereby all previously existing life was destroyed. The flask was then allowed to cool, the entering air being filtered through a plug of glass wool or asbestos. The flask was then inoculated with a small quantity of previously-cultivated hay solution or Pasteur's fluid. Hydrogen, oxygen, carbonic oxide, marsh-gas, nitrogen, and sulphuretted hydrogen, were without effect on the bacteria. Chlorine and hydric peroxide (about 7 per cent of a 5 vol. solution) were fatal to bacteria. The action of various salts and organic acids in 5 per cent solution was tried. Many, including potash, soda, potassic bisulphite, sodic hyposulphite, potassic chlorate, potassic permanganate, oxalic acid, acetic acid, glycerin, laudanum, and alcohol, were without effect on the bacterial life. Others—the alums, ferrous sulphate, ferric chloride, magnesic and aluminic chlorides, bleaching-powder, camphor, salicylic acid, chloroform, creosote, and carbolic acid—decidedly arrested the development of bacteria. The author has made a more extended examination of the action of chloroform, especially as regards the statement of Muntz, that bacteria cannot exist in the presence of 2½ per cent of chloroform, which substance is therefore useful in distinguishing physiological from chemical ferments. The author concludes that amounts of chloroform, phenol, and creosote, varying from ½ to 3 per cent, do not destroy bacteria, although their functional activity is decidedly arrested while in contact with these reagents. To use the author's words, bacteria may be pickled in creosote and carbolic acid without being deprived of their vitality. The author concludes that the substances which destroy bacteria are those which are capable of exerting an immediate and powerful oxidising action, and that it is active oxygen, whether from the action of chlorine, ozone, or peroxide of hydrogen, which must be regarded as the greatest known enemy to bacteria.

Mr. Hamlet, in replying to some remarks of Messrs. Kingzett and Williams, said that in all cases the solution which he had used had been completely sterilised by exposure to a temperature of 105° for ten minutes. The india-rubber tubing he had used was steamed. Carbolic acid solution must contain at least 5 per cent of carbolic acid to be fatal to bacteria. He was quite aware of the importance of distinguishing between the action of the substances on various kinds of bacteria, and was quite prepared to admit that a treatment which would be fatal to one kind of bacterium might not injure another.

The Society then adjourned to April 21st, when a paper "On the Estimation of Hydric Peroxide by Means of Potassic Permanganate," by W. E. Adeney, will be read.

PHYSICAL SOCIETY.

Saturday, April 9, 1881.

Prof. W. G. Adams in the Chair.

Prof. Helmholtz was elected an Honorary Member of the Society, and Dr. James Moser an Ordinary Member.

Dr. J. H. Gladstone read a "*Note on Thermal Electrolysis,*" by himself and Mr. Alfred Tribe. The authors found that when sheet silver was plunged into fused silver chloride, or iodide of silver, crystals of silver formed on the sheet. Similarly, copper immersed in fused cuprous chloride, had copper crystals deposited on it; and when zinc was placed in melted zinc chloride, or iron in melted ferrous chloride, these two metals crystallised on the plates. They found this to be due not to a difference in the physical condition of the rolled metals, but to the unequal heating of the different parts of the immersed metals. By the contact theory of Voltaism there will be a difference of potential between the metal and the liquid chloride in contact with it, and this difference of potential will vary with temperature. Since all parts of the immersed metal cannot be supposed at the same temperature always, there is the possibility of a current being set up, and consequent electrolysis of the salt. This view was corroborated by heating the metal unequally, when a crop of crystals appeared in the cooler part of the liquid. Again, two silver rods connected together were plunged, the one in a hotter, the other in a cooler part of fused silver chloride, and at the end of fifteen minutes the latter was studded with crystals of silver, whilst the former was clean. A galvanometer showed a stronger current between the rods the greater the difference of temperature between the parts of the fluid in which they were placed, and transposing the rods reversed this current. These experiments bear on the nature of voltaic action, and form a lecture illustration of the conversion of heat into electricity and chemical force.

Mr. W. H. Walenn stated that he had found, when zinc is immersed in an electro-brassing solution, crystals of brass (*i.e.*, zinc and copper) were deposited on it.

Capt. Abney exhibited a number of photographic negatives, taken by himself and Col. Festing by radiation through thin sheets of ebonite. The light from the positive pole of an electric lamp was sent through a thin sheet of ebonite, 1-64th inch thick, and photographs taken showed the radiation to have a low wave-length from 8000 to 14,000. The carbon-points of the lamp could be photographed through the sheet, and Col. Festing observed the sun's disk through it. The ebonite showed a grained structure, and different examples of ebonite gave different results, but all gave some result in course of time at least; old ebonite, like that used in some of Mr. Preece's experiments, scattering the light more than new ebonite.

Dr. Moser exhibited the passage of the rays through the ebonite to the audience, by means of a galvanometer.

Prof. Guthrie observed that Capt. Abney had proved that light as well as heat traversed the ebonite.

Dr. Coffin stated that the composition of ebonite, apparently the same, might vary considerably, and hence its transparency might vary too.

Prof. Helmholtz addressed the meeting on the Localisation of Objects by the Eyes. We estimate distance with one eye by the outlines of the more distant objects being covered by the nearer ones where they meet, and by the shadows thrown by the anterior objects. These conditions are very rarely overpowered by others, as, for instance, binocular vision. This is shown by Dove's pseudoscope, and the fact that closing or blinding one eye makes little difference to the power of judging distance, especially when not very close to the eye. The relative shifting of objects as the eye is moved from side to side, or to and fro, or up and down, which may be called the parallax of motion of the head, is also a strong factor in estimating distance. The author had concluded from a study of the stereoscope that the perception of the absolute convergence of our eyes is very indistinct, and that only differences of convergence related to apparently near or distant objects produce the stereoscopic effect. More recent observations of his show that the incongruity between the degree of convergence and the parallax of motion is perceived with great accuracy.

Dr. Stone remarked that a person suddenly blinded in one eye acquires a new judgment of distance by moving the head (a habit seen in nocturnal birds); and in taking certain French stereoscopic pictures, the camera is shifted from one point to another, so that the combined images produce an impression of smallness in the object. These facts corroborate Prof. Helmholtz's view.

Mr. Lewis Wright pointed out that santonin, which changes the sense of colour, also appears to change the sense of distance.

PHILOSOPHICAL SOCIETY OF GLASGOW.

Chemical Section.

Monday, February 21, 1881.

Mr. J. Mactear, F.C.S., F.I.C., President, in the Chair.

Mr. J. J. Coleman, F.C.S., F.I.C., read a paper "*On the Removal of Aqueous Vapour from the Atmosphere.*" He said:—

The absolute weight of moisture contained in any given volume of air, and at any particular temperature, is usually calculated from a table of vapour-tensions by a formula well known to meteorologists, so that the accuracy of the results depend upon the care with which the table of vapour-tensions has been compiled from direct experiment. Fortunately for this as well as other branches of Physics, we have the exact experiments of Regnault, which, in the case in point, were carried down to about 20° below zero of Fahr. scale: but as at that temperature the tension of water vapour is only 0·017 of an inch of mercury, it is quite obvious that errors of experiment would be apt to increase to a serious extent in carrying observations to lower temperatures by the method adopted by this experimentalist. One of the earliest papers that the late Professor Rankine wrote was one on the "Elasticity of Vapours" (*Edinburgh New Philosophical Journal*, July, 1849), in which he says—"I have obtained amongst other results an equation giving a very close approximation to the maximum elasticity of vapour in contact with water," and from three constants—viz., the vapour-tension at 220° C., at 100° C., and at 26° C.—he calculated theoretically the vapour-tensions for every 10°—from 230° to 20° below zero, which corresponds almost exactly with Regnault's experiments. In reference to this formula, Prof. Rankine observed that it may be employed without material error for a considerable range beyond what he proved it, but that it can be only regarded as an approximation to the exact physical law of the elasticity of vapours for the determination of which many constants are still wanting which can only be supplied by experiment. The principal point involved in such an enquiry is the question as to whether aqueous vapour ceases to have elasticity at any point short of absolute zero. Passing, however, from such remote considerations, and directing attention to the absolute weight in grains per cubic feet of vapour at various temperatures, I have been led to notice the ratio in which vapour is liquefied by regular diminutions of temperature from 100° F. above zero down to zero itself. On the tabular statements accompanying this paper I have given two columns of figures, the first column up to half its length containing the actual weight in grains of a cubic foot of saturated vapour, as given in Glaisher's hygrometric tables, and for temperatures which decrease at the uniform rate of 10° down to zero. Directly underneath these figures I show the ratio in which the weight decreases for every drop of 10°. Thus saturated vapour, in dropping from 100° to 90° deposits 25 per cent of its weight; from 90° to 80°, 26 per cent of its weight; from 80° to 70°, 27 per cent of its weight, and so on, the ratio increasing almost uniformly at the rate of 1 per cent every fall of 10°; so that by the time the temperature gets to 10° above zero it parts with 35 per cent of its weight in falling 10° lower to zero. It seems reasonable, therefore, to suppose that some similar ratio of decrease will be maintained for temperatures far below zero, and in accordance with this view I have ventured to extend the line of figures to a temperature of 120° below zero, from which I have calculated the figures on the remaining half of the column above alluded to, thus showing the probable weight of a cubic foot of vapour for every 10° to 120° below zero.

	Temperatures.	Weight of cubic foot of Saturated Vapour in Grains.	Percentate of Weight Deposited for Fall of 10° in Temp.
Glashier's Tables above zero F.	100	19·84	25
	90	14·85	26
	80	10·98	27
	70	8·01	28
	60	5·77	29
	50	4·10	30
	40	2·86	31
	30	1·97	34
	20	1·30	35
	10	0·84	34·5
	0	0·55	35
Calculated below zero F.	10	0·36	36
	20	0·23	37
	30	0·14	38
	40	0·08	39
	50	0·05	40
	60	0·03	41
	70	0·017	42
	80	0·009	43
	90	0·005	44
	100	0·003	45
	110	0·0015	46
	120	0·001	47

The result can, of course, only be considered as an approximation, for in reality the ratio of liquefaction must be accelerated to ensure complete liquefaction at a point above absolute zero; but, at any rate, it is very clear that at a temperature of 120° below zero, a cubic foot of saturated aqueous vapour does not weigh more than the thousandth part of a grain, or 1-536,000 part of the weight of the same volume of dry air at 60°, or about 1-800,000 of the weight of a cubic foot of dry air at 120° below zero.

I have also thought it might be interesting to put the result in the form of a graphic curve, the vertical figures representing the weight of a cubic foot of vapour, and the horizontal figures representing the temperature commencing at 100° above zero, and ending at 100° below zero. One of the most curious facts that strikes the eye is the independent influence of the freezing-point of water upon this curve, although there is a little irregularity. There is no sudden deposition of moisture when the freezing-point is attained—ice, in fact, imparting humidity to air just as water had previously done before the freezing-point was attained. With a view to consider for a moment the joint effect of cold and pressure upon aqueous vapour, I have now to remind you of a well-known law of Physics, viz., that when saturated vapour is subjected to pressure it will liquefy in the direct ratio of the pressure, temperature being constant; and also that atmospheric air saturated with aqueous vapour behaves in this respect just the same as if the air were not present. This principle was illustrated by Dalton, who introduced volatile liquids into the Torricellian vacuum of a barometer tube, and showed that the liquids evaporated or recondensed in proportion to the elevation or lowering of the tube in a mercurial trough. Assume, then, that air at 60° F. and saturated with moisture is compressed to 20 atmospheres, and in a surface condenser consisting of a suitable system of tubes surrounded by an ample supply of water at the initial temperature of the air, then 19-20ths of the weight of that aqueous vapour should be deposited as dew in the inside of the pipes. If the volume of the air at starting were 1 cubic foot at 60°, then it would contain 5·8 grains of water, and when compressed to 20 atmospheres without change of temperature 5·5 grains would be deposited, and being expanded again to its original volume and pressure, out of contact with the deposited water, it would be found to contain only 3 grains of water. Going a step further, let us suppose that the same cubic foot of vapour saturated air at 60° is compressed into one-twentieth its bulk in another way, viz., in direct contact with water, —say by forcing it into a strong reservoir partially filled with water. Imagine the compressed air and water to be shaken together and then allowed to stand until perfectly quiescent, the temperature being kept at 60°: now let the water be carefully drained away, or detached from the compressed air, and the air be expanded to its former bulk, and it will be found to be drier than it was at the start, as it will have lost nineteen-twentieths of its vapour just as in the former case. Thus we are brought face to face with a curious paradox—that it is possible to dry air by wetting it. Both of the methods of drying air I have thus described are limited in practice by the difficulty on the one hand of getting temperatures under 100° below zero, and on the other hand, of compressing air in a continuous current to higher pressures than 20 atmospheres. But it is manifest that if the two operations be combined, air might be dried so as not to contain more than the 10,000,000th part of its weight of vapour. It is an interesting question how these figures compare with the result of desiccating air by chemical methods. According to H. C. Debbit (abstract of whose paper on the subject appeared in the *Journal of the Chemical Society*, October, 1876), anhydrous phosphoric acid is the most powerful desiccating agent, and he states that this substance will remove the 2,000,000th part of the weight of air in the form of moisture, even after it has been carefully dried by sulphuric acid at temperatures not exceeding 25° C. When the anhydrous phosphoric acid, he says, was made to act upon air which had been previously dried over sulphuric acid at 50° C. no less than the 1,000,000 part of its weight proved to be aqueous vapour. Calcium chloride seemed to be a worse desiccator than sulphuric acid, or at any rate its power of desiccation seems to be within very small ranges of temperature, as the author observes that if air be dried by passing over this salt at a given temperature, and be brought into contact with a fresh quantity of the salt at a lower temperature, a further absorption of water takes place, but that if the second portion of chloride of calcium be maintained at a higher temperature than the first the air becomes moister. In reference to this subject it may be interesting to refer to the paper of Professor Tyndall, recently read to the Royal Society, "Upon the Action of an Intermittent Beam of Radiant Heat upon Gaseous Matter," in which he describes experiments made by passing radiant heat through flasks containing varying quantities of aqueous and other vapours. Tyndall shows that the more vapour there is present in air the more easily are the heat pulsations converted into audible noise on the principle of Graham Bell's recent discoveries. Dry air, in fact, gave no sounds whatever which could be detected, whilst minute quantities of many vapours added to the air occasioned sounds which could be compared in intensity with those of an organ pipe. Amongst other experiments he mentions that Prof. Dewar supplied him with four flasks, the first containing air dried by chloride of calcium, the second air dried by strong sulphuric acid, the third by Nordhausen acid, and the fourth by phosphoric anhydride: and, curious to say, the flask containing the phosphoric anhydride emitted the strongest sound, which is the exact reverse of what should be the effect if phosphoric acid were the best desiccant. Even with sulphuric acid, the extreme difficulty of drying air was very evident, for Tyndall remarks that air kept over the surface of this acid for twelve hours emitted sounds, which, however, entirely disappeared when the time of contact was increased to eighteen hours. This beautiful method of investigation will doubtless be followed up, and it is to be hoped will clear up many points connected with the relative efficiency of desiccants. In regard to the strictly mechanical method of drying air described in the first part of my paper, it has been to some extent practically carried out in the construction of Bell-Coleman cold-air machines used for the Oceanic conveyance of meat and other provisions. In these powerful machines, and of the size most usually employed in the Transatlantic traffic, about 36,000 cubic feet per hour of atmospheric air are taken into the air compressers; and supposing this air is two-thirds saturated, and of a temperature of 80° F., it contains $37\frac{1}{2}$ lbs. water vapour, some of which must be removed before the air is finally discharged from the machine below zero, or the discharged air would become loaded with clouds of snow, which would be a great practical inconvenience. But in point in fact, about half this aqueous vapour is at once deposited, and mingles with the water which is freely injected into the compresser to keep down the heat produced by the compression, and escapes therefrom by a pipe controlled by a ball-cock before the compressed air is allowed to expand; it is made to traverse a great number of small pipes, the external surface of which are cooled by the waste cold air—say of 30°—coming from the provision room being refrigerated. So that by this means a very considerable cooling of the compressed air is effected, causing a further liquefaction of vapour, by which, in fact, its quantity is practically halved. Thus, by the time the air gets to the expansion cylinder, where expansion takes place in the act of doing work, the air, although it has been freely washed with fresh water, contains only about one-fourth of the aqueous vapour which it contained at the start of the cycle, and can be expanded without producing any inconvenient amount of snow. The temperature at the moment of expansion is generally from 30° to 50° below zero, or 100° below zero when the machine is worked at about four atmosperes of condensation. This method of producing cold dry air has not only been employed in cold-air machines working across the Atlantic, but has also been recently found to work well with machinery traversing the Red Sea and Indian Oceans.

A Result of the Cultivation of Flax in Saxony, and the Yield of Flax in Belgium and Westphalia.—Belgian flax loses 24 per cent in steeping, and that of Westphalia 30 per cent.—*Biedermann's Central-Blatt.*

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Biedermann's Central-Blatt für Agrikultur-Chemie,
August, 1880.

Experiments on the best manner of Applying Artificial Manures to Potatoes.—Patow-Lalendorf.—Harrowing the manure in gave a better result than hoeing it in. Peruvian guano produced the heaviest crop.

Researches on the Reversion of Superphosphates.—M. A. Millot.—The author contends that in the analysis of superphosphates, not merely the soluble phosphoric acid (as customary in Germany and England) or the sum of the soluble and the reverted (as usual in France and Belgium), should be determined, but each of these forms separately. He finds that if mineral phosphates contain a considerable amount of ferric oxide, even if a sufficient quantity of sulphuric acid is used, a part of the phosphoric acid combines with iron, and forms phosphates insoluble in citric acid. Acid calcium phosphate behaves like phosphoric acid, bicalcium phosphate being formed; not, as Joulie maintains, the triphosphate. Alumina, at common temperatures, forms only phosphates soluble in citric acid. Calcium carbonate mixed with superphosphate combines with phosphoric acid, and even in an acid mixture there is a formation of bicalcium phosphate or of the tri-salt if the quantity of carbonate is sufficient. This reversion appears more considerable than it really is if neutral citrate is used instead of the ammoniacal.

Action of Artificial Manures upon Hungarian Wheat Soils.—A. Schumaker.—The manured plots gave in all cases heavier crops than the unmanured, but the financial result was distinctly unfavourable.

Determination of Reverted Phosphoric Acid with Ammonium Citrate.—A. Grupe, Prof. B. Tollens, Dr. Crispo, Prof. Petermann, and M. P. Chastaign.—Grupe and Tollens find that the calcium phosphates soluble in citrate are transformed into calcium citrate and ammonium phosphate, the former salt being soluble in an excess of the liquid. Not merely dicalcium—but to some extent tricalcium—phosphate is dissolved if it has not been very strongly dried. Phosphoric acid in ammonium-magnesium phosphate cannot be determined by this method. The solvent action of the citrate liquid is greater at 35° than at common temperatures. Threefold the calculated quantity of magnesia-mixture gives approximately accurate results. Crispo pronounces the method in need of improvement, and shows that the presence of calcium carbonate or magnesia in any form renders the phosphoric acid, which has been dissolved on treatment with ammonium citrate, insoluble again. Thus there is often found less phosphoric acid soluble in the citrate-liquid than in water. M. P. Chastaign finds too low figures for the phosphoric acid in superphosphates in presence of magnesia. He proposes to extract first with water, and then to treat with ammonium citrate—a suggestion with which Petermann agrees. He wishes to confine the determination of phosphoric acid soluble in water to dissolved guano and bone superphosphates.

Certain Relations between Muscular Activity and Decomposition of Matter in the Animal Organism.—Dr. O. Kellner.—The requirement of an organism for the exertion of energy can become a cause of the decomposition of the components of the nutriment and of the body. Non-azotised materials are first attacked, and if such are insufficient or have been consumed a decomposition of the organised albumen takes place. This decomposition of the albumen of the body can only be arrested by an increase of food, especially of its non-nitrogenous portion. Even a very abundant supply of albumen cannot prevent the destruction of organised albumen if the total quantity of nourishment is not sufficient for the requirements of the force to be exerted. It is possible and probable that in consequence of the increased demand for oxygen during work a larger quantity of circulating albumen is necessary than the minimum required by the organism when at rest.

Experimental Production of the Fungus of Splenic Fever.—H. Buchner.—The genetic connection of the bacteria of splenic fever with the hay fungi and the possibility of the transformation of each into the other is completely proved. The author has not succeeded in producing splenic fever with the unmodified hay-fungus.

Solidity of Timber at Different Times of the Year.—Von Nördlinger.—The average resistance to pressure in the month of February is expressed by the number 5·40, whilst in August it reaches a minimum of 3·28.

Artificial Influence on the Difference of Development of the Upper and Lateral Eyes of Potatoes, and on the Conditions of the Formation of Tubers.—Dr. K. Kraus.—Not suitable for abstraction.

Cultivation of the Beets.—Prof. E. Wollny.—Not suitable for abstraction.

Wickersheim's Process for the Preservation of Organic Substances.—H. Struve and O. Jacobsen.—The original formula was 100 c.c. water, 40 c.c. glycerin, 10 c.c. methylic alcohol, 3·33 grms. alum, 0·83 grm. common salt, 0·40 grm. saltpetre, 2 grms. potash, and 0·66 grm. arsenious acid. The author points out that the alumina will be completely precipitated by the potash, and proposes in place of both alum and potash an equivalent quantity of potassium sulphate. The following two modifications of the fluid are now in use, the former for injections and the latter for steeping objects to be preserved:—

Arsenious acid..	16 grms.	12 grms.
Sodium chloride	80 ,,	60 ,,
Potassium sulphate.. ..	200 ,,	150 ,,
Potassium nitrate	25 ,,	18 ,,
Potassium carbonate ..	20 ,,	15 ,,
Water	10 litres	10 litres
Glycerine	4 ,,	4 ,,
Common methylic alcohol	$\frac{3}{4}$,,	$\frac{1}{2}$,,

Justus Liebig's Annalen der Chemie,
Heft 2, 1880.

On Inuline.—H. Kiliani.—A very extensive memoir on the history, preparation, composition, behaviour, and derivatives of this substance.

Cinchonidine and Homo-cinchonidine.—O. Hesse.—A very complete account of these bases and their salts. The author has not succeeded by any method in converting homo-cinchonidine into cinchonidine, or in effecting the inverse transformation. He considers these alkaloids as distinct.

On Cinchonine.—O. Hesse.—The author considers the assumption of the presence of several cinchonines in the commercial preparation as inadmissible.

Optical Determination of Cinchonidine Sulphate in Commercial Quinine Sulphate.—O. Hesse.—The author considers that optical examination is the best method of detecting the cinchonidine salt. He describes certain improvements on his process given in *Annalen*, 182, p. 154.

Absorption of Oxygen by Pyrogallol in an Alkaline Solution.—T. Weyl and X. Zeitler.—The conclusion arrived at is that the absorptive power of pyrogallol in an alkaline solution is a function of the alkalinity of such solution.

Hydro-ferro-cyanic Acid in its Compounds with the Amines.—L. J. Eisenberg.—The author describes the acid dimethyl-aniline compound, the neutral, and the acid aniline salts, and the meta-toluidine, ortho-toluidine, and oxylidine compounds.

THE CHEMICAL NEWS.

VOL. XLIII. No. 1117.

ON THE ATTENUATION OF THE VIRUS OF CHICKEN CHOLERA.*

By L. PASTEUR.

OF the various results which I have had the honour of communicating to the Academy concerning the disease commonly called Chicken Cholera, I will take the liberty of recalling the following:—

1. Chicken Cholera is a virulent disease of the highest order.
2. The virus is a microscopical parasite, which may be multiplied by cultivation outside of the body of an animal.
3. The virus presents various degrees of virulence. Sometimes the disease is followed by death; at other times, after giving rise to morbid symptoms of variable intensity, these are followed by cure.
4. The difference noted in the power of various viruses are not merely the results of observations made of natural phenomena, for the experimenter can give rise to them at will.
5. As generally happens with virulent diseases, chicken cholera does not recidivate, or rather it may be said that recidivation is in inverse ratio to the intensity of the first attack of the disease, and it is always possible to carry the preservative action far enough to prevent the most virulent virus from producing any effect.
6. Without wishing to affirm anything at this time on the relations of the virus of variola to that of vaccine, there appears from the foregoing that in chicken cholera there are conditions of the virus which, relatively to the most virulent virus, act as human vaccine to the virus of variola. Vaccine virus gives a mild disease, but preserves from a more serious disease, variola. In the same manner the virus of chicken cholera presents, in certain conditions, an attenuated virulence which gives the disease but does not cause death; and after cure has been effected, the animal may without danger be inoculated with the most virulent virus. There is, however, a great difference between these two sets of facts, and it must be acknowledged that in some respects the advantage is with investigations relating to chicken cholera, as far as knowledge and principles are concerned; for while discussions continue on the relations of vaccine to variola, we possess the assurance that the attenuated virus of chicken cholera is derived from the very virulent virus proper to this disease, that we may pass directly from one form of the virus to the other. This fundamental nature of each is the same.

The time has come for me to give explanations concerning the main fact of the preceding prepositions, which is that there are variable states of virulence in chicken cholera. This must certainly seem a strange result if we bear in mind that the virus of this affection is a microscopical organism, which may be cultivated in a state of perfect purity, as might be done with beer yeast or with the mycoderm of vinegar. If we reflect on this mysterious problem of variable virulence, we are led to think that this characteristic is probably common to the various species of this group of virulent diseases. Where is, then, the distinctive character which belongs to these diseases? To cite only one example:—We often see very severe epidemics of variola, and others of a milder type, without the possibility of ascribing these differences to the variable conditions of climate or of individual constitutions. We also see great contagia become gradually extinct, to reappear again and again to become extinct.

The idea of the variable virulence of the virus is not, then, of such a nature as to surprise physicians and educated persons, but nevertheless it becomes interesting to establish it on scientific bases. In the particular case we have before us the mystery lies in this, that the virus is a microscopical organism, and that the degree of virulence depends on the observer. This I mean to establish beyond doubt.

Let us take as starting-point the virus of cholera in its most virulent form. I have already given a process for obtaining it with the maximum of virulence, which consists in taking it from a chicken that has recently died, not from the acute disease, but from the disease in its chronic form. This form sometimes presents itself, although rarely. The chicken resists the disease for weeks and even months. When it has died, which happens when the parasite, after being localised, finally passes into the blood, we may observe that whatever may have been the virulence of the virus originally inoculated, the virus from the blood of the animal who has taken so long to die is of such virulence that it kills in every case. If we make successive cultivations of the virus obtained in this way, in a pure state, in a broth made from chicken's muscles. by starting each cultivation from the preceding one, and if we make trials from each successive cultivation, we will find that the virulence does not vary in an appreciable degree. In other words, if we make this convention, that two cultivations have the same degree of virulence when on operating in the same conditions on animals of the same species the proportion of deaths is the same, we say that in our successive cultivations the virulence remains the same.

In what I have said I have not made any mention of the interval of time between the beginning of one cultivation to the beginning of the next, and of the possible influence of this interval on the degree of virulence. I will now call your attention to this point, although its importance may appear small. For an interval of from one to eight days, the virulence does not seem to change. For an interval of fifteen days, we have the same result. For an interval of a month, of six weeks, or of two months, there seems to be no diminution of virulence. Nevertheless, as the interval becomes greater there appear signs of little apparent value that the virus has become weaker. For instance, although the proportion of deaths remains the same, the rapidity with which chickens die does not seem to be so great. In the various series of inoculated chickens, some seem to linger, although very ill and sometimes very lame, as the parasite has settled in their thighs. The pericarditis is of milder type, and abcesses occur around the eyes. The disease seems to have lost its overwhelming character. We may make the intervals still greater: we may put three months, four months, five months, eight months between two successive cultivations. Then we obtain entirely different results, for the degrees of virulence, which formerly were not perceptible, now become well marked by apparent effects.

By such long intervals between successive seminations, it happens that the next cultivation does not present mortalities of ten for ten inoculations, but decreasing mortalities of nine, eight, seven, six, five, four, three, two, one for ten inoculations, and sometimes there are no deaths, which means that the disease shows itself on all the subjects inoculated, and they all recover. In other words: by simply changing the process of cultivation of the parasite; by merely placing a longer interval of time between successive seminations, we have obtained a method for decreasing virulences progressively, and finally get at a vaccinal virus which gives rise to a mild disease, and preserves from the deadly disease.

---

* Translated from *Comptes Rendus de Académie des Sciences* of October 25, 1880, by P, Casamajor.

We must not think that for all these attenuations things proceed with mathematical fixedness and regularity. A cultivation which has stood for five or six months without renewal may show remarkable virulence, while another may be considerably attenuated after waiting three or four months. We will very soon explain these irregularities, which are only apparent. Often even there is an abrupt passage from a condition of notable virulence to the death of the parasite for an interval of short duration. In passing from one cultivation to the next we are sometimes surprised to find that further development has become impossible. The parasite has died. The death of the parasite is an event which often occurs when sufficient time has elapsed after a new semination has been begun.

Now this Academy understands the true reason of the silence I have kept, and of the liberty I asked to delay information on my method for effecting the attenuation of the virus. Time was an element in my researches.

While the various phenomena are taking place, what becomes of the microscopical organism? Does its shape and aspect change, while its virulence is changing in such a marked manner? I would not dare to affirm that there does not exist certain morphological relations between the parasite and the various degrees of virulence which it shows; but I must confess that it has not been possible for me to seize them. If any such relations sometimes appear, they disappear again to the eye working through a microscope, on account of the extreme minuteness of the virus. The cultivations seem to be the same for all degrees of virulence. If sometimes slight changes are seen they seem to be entirely accidental, for in the next cultivation they either disappear or even sometimes inverse changes take place.

A remarkable circumstance is that if we take each variety of virulence as a starting-point from which to make new cultivations, at short intervals, each variety of virulence keeps its own intensity. If, for instance, we have an attenuated virus which can only kill once in ten times, it will keep the same degree of virulence in its successive seminations if the intervals are not too great. A very interesting circumstance, although in accordance with the preceding observations, is that an interval of semination which may be sufficient to cause the death of an attenuated virus has no sensible influence on a more virulent virus, although this may, in its turn, become afterwards attenuated to a marked degree.

Now that we have arrived at this point, a question presents itself which relates to the cause of the attenuation of virulence.

The cultivations of our virus must take place in contact with air, because our virus is aërobian, and, without air, its development becomes impossible. We are then naturally led to ask whether the attenuation of the virus is not due to contact with the oxygen of air. Would it not be possible that the small organism which constitutes the virus, when left in contact with the oxygen of pure air, in the medium of cultivation in which it has developed, may have been modified, and the change remains permanent, even after the organism has been withdrawn from the modifying influence? We may also enquire whether some chemical principle in the atmosphere, other than oxygen, does not intervene in this phenomenon, the singularity of which almost justifies my hypothesis.

It is easy to understand that the solution of this problem, in case it depends on our first hypothesis, that the phenomenon is due to the oxygen in the atmosphere, may be tried by experiment. If oxygen is in reality the cause of the attenuation of virulence, we may have, to a certain degree, a proof of it by noting the effect of suppressing it.

To test this, let us conduct our cultivations in the following manner:—We may take a certain quantity of our chicken broth, and place in it the most virulent virus, and fill with it a series of glass tubes up to two-thirds, three-quarters, &c., of their volumes. These tubes may then be closed over the lamp By the presence of the small quantity of air left above the liquid the development of the virus may be started, which is ascertained by the increasing turbidity of the liquid. The development of the cultivation gradually absorbs all the oxygen contained in the tube. The turbidity then diminishes, the growth is deposited on the sides of the tube, and the liquid becomes limpid. This takes place generally in two or three days. The microscopic organism is then deprived of oxygen, and will remain in this condition as long as the tube is not opened. What will become of its virulence? To be sure of our results we will have prepared a great number of such tubes and an equal number of flasks, which last will continue to be left in contact with pure air. We have already spoken of what becomes of cultivations carried on in presence of air. We know that they experience a progressive attenuation of their virulence, and we will not return to this subject. Let us now only pay attention to the cultivations in closed tubes. Let us open them—one after an interval of a month, another after three months, and so on until we open one that has stood ten months. I have not gone any further at the present time. It is a remarkable circumstance that the virulence in all these cases is of the same degree as that of the liquid which served to fill up the tubes. As to the cultivation exposed to the air, they are found either dead or in a condition of feebler virulence.

The question we have proposed is then solved: it is the oxygen of the air which attenuates and extinguishes the virulence.

To all appearances we have here what is more than an isolated fact. We must have reached to a general principle. We may suppose that an action which is inherent to atmospheric oxygen, an agent present everywhere, has the same influence on other viruses. At any rate it is worthy of interest that possibly a general cause of attenuation exists dependent on an agent which is in a manner cosmical. Can we not suppose even now that it is to this cause that we can attribute in the present, as in the past, the limits set to great epidemics.

The facts which I have had the honour to communicate to the Academy suggest many proximate and remote inductions. From all these I must hold back with reserve. I will not feel authorised to present them to the public, unless I make them pass into the domain of demonstrated truths.

LABORATORY OBSERVATIONS.

By FREDERICK FIELD, F.R.S.

At the conclusion of "Laboratory Observations," in the Chemical News, vol. xliii., p. 75, it was stated that they had extended to the action of certain organic substances upon the rose colour, produced by the solution of platinic iodide in potassic iodide. The following notes may not be without interest. Solutions of starch, cane- and grape-sugar, gum, dextrin, gelatin, glycerin, nitrous and oxalic acids, and many other substances have no perceptible action upon the rose colour, even when they are highly dilute. Neither has urea nor uric acid; but urine, albumin, tannic, gallic, and pyro-gallic acids, potassic cyanide and sulphocyanide, and the liquids in which meat or vegetables have been boiled, destroy the colour with greater or less rapidity.

It occurred to me that these facts might have some value, as, although the results were not conclusive as to the actual existence of any one body in the liquid, the *negative* result, in this instance, viz., the non-change of colour, would be a tolerable certain evidence of the freedom of the added solution from substances possessing a deleterious influence. Thus, although the presence of gallic or tannic acids would cause the disappearance of the tint, albumin, urine, sewage water, and the water of wells near a cesspool would have a similar effect. The resistance of the colour to the influence of the liquid would prove the absence of all the above substances, whether baneful or harmless.

A solution was made containing one part of platinic chloride in 500,000 of a very dilute solution of potassic iodide. 50 c.c. of the liquid were placed in a series of wide glass test-tubes, and a similar volume (50 c.c.) of the following were added to each, and thoroughly mixed. The original solution had a clear bright rose colour.

Water from the Thames taken at high and low tide at Lambeth.—No great effect. There was a simple dilution of colour owing to the addition of the colourless liquids.

Water from the various London companies.—No perceptible changes, but in one or two instances the colour faded considerably in the course of twelve hours.

Water from the main drainage, after the sewer had been recently "flushed."—Speedy decolorisation.

Water from same sewer, having a slightly disagreeable odour.—Instantaneous destruction of colour, even when diluted with ten times its volume of pure water, *i.e.*, 5 c.c. of sewage to 45 c.c. water.

Water in which vegetables and meat had been boiled.—Similar result.

1 c.c. urine added to 49 c.c. water destroyed the colour after a few minutes.

1 c.c. solution of albumen prepared by dissolving the white of one egg in 200 c.c. water, immediately discharged the colour from the platinum salt.

Dilute solutions of gallic, pyro-gallic, and tannic acids. —Same reaction: as well as potassic cyanide and sulphocyanide.

Saliva also destroyed the colour.*

On the contrary—

Solution of urea	No effect.
,, uric acid	,,
,, starch	,,
,, gum	,,
,, dextrin	,,
,, cane-sugar	,,
,, grape-sugar	,,
,, glycerin	,,
,, gelatin	,,
,, oxalic acid	,,
,, tartaric acid	,,
,, citric acid	,,
,, acetic acid	,,
,, carbon disulphide	,,
,, alcohol	,,

From the above experiments it would appear that many organic substances which speedily decompose potassium permanganate do not affect the platinum salt. As it was thought that the platinic iodide employed was rather too dilute, 1 part in 200,000, in place of 1 in 500,000, was employed. This solution has a rich ruby colour, and seems affected in the same degree, though, perhaps, not quite so readily. The reaction of a solution of albumen is by far the most striking of any of the results mentioned above. The splendid red tint on the addition of a few drops of that liquid instantaneously disappears. This would be a good lecture experiment, although by no means conclusive of the existence of albumen.

Such are some of the observations which have been made, and must be regarded merely *as* observations, having, perhaps, no great scientific interest in themselves. It may be, however, of some importance to the chemist to know that an equal volume of water added to a solution of platinum iodide of the strength above given, and retaining its colour, may be regarded as comparatively free from sewage contamination and from albuminous matters, although it may contain nitrites and nitrates. The water from wells, unfortunately near a cesspool, could thus be easily tested. The destruction of colour *might* give a false alarm; the retention of tint, would, to say the least, be consolatory.

---

* I am not aware that it is generally known that iron cannot be recognised in urine (the metal as a ferric salt) by means of potassic sulphocyanide, unless excess of hydrochloric acid is present. This must be due to the phosphates, which destroy the red colour. Potassium sulphocyanide exists in saliva, and it is a well-known experiment to add a drop of ferric chloride to that secretion and mark the characteristic tint. If a trace of sodic phosphate be present there is no change of colour, which is developed, however, on the addition of hydrochloric acid.

METHODS FOR JUDGING OF THE WHOLESOMENESS OF DRINKING WATER.*

By REUBEN HAINES.

(Concluded from p. 174).

Wanklyn's method is also unsatisfactory and unphilosophical as a scientific quantitative method, because it assumes that most of the organic material usually found in drinking water is in its general character similar to animal and vegetable albumin. This is an assumption which no one has yet proved to be correct, and it is difficult to perceive how it can be proved until we know definitely what these specific materials are, which it is impossible to determine in the present state of our knowledge. Wanklyn found that pure albumin yielded by this method about two-thirds of its total nitrogen as ammonia, and that this proportion was quite constant. That this is also true of organic matter in water cannot at present be proved. He proposed at first to calculate the total organic matter as ten times the albuminoid ammonia, but this he has since, evidently, and it should be said rightly, rejected as both unscientific and really not necessary for the practical judgment of the sanitary character of water by his method.

Those who are familiar with the most recent sanitary experience realise that it is the *quality* rather than the *absolute quantity* of organic matter that is the most important factor in the sanitary judgment of a drinking water. A water which contains a large amount of one kind of organic substance may be much more wholesome, or far less unwholesome, than that which contains only a small amount of another kind. It is a matter of actual experience that a water, notwithstanding it contains a large amount of nitrogenous organic matter capable of yielding albuminoid ammonia, may be found to be practically wholesome, or at least may be drunk for a long period without apparently producing any injurious effects; while, on the other hand, a water which contains *even a minimum* of organic substance capable of yielding albuminoid ammonia may nevertheless contain or develope the *materies morbi* or unknown causal "something" of a specific disease.

While Wanklyn's ammonia method is certainly a very easy and expeditious performance, yet great caution is necessary in the formation of an opinion from the analytical results; and thus it may frequently happen that serious mistakes may be made through hasty conclusions from insufficient data. It is said very truly that a really very bad water will rarely, if ever, escape condemnation, and an exceedingly pure water will undoubtedly be shown to be pure, so far as this is possible by any chemical investigation. But by far the larger number of well waters more especially lie between these extremes, and must take their place under the head of Doubtful Purity, and it is in the judgment of the latter that the analyst is liable to error, even to the extent of rendering an opinion diametrically the opposite of that of another chemist.

One of the precautions necessary to be taken in these, and in fact in all cases, is to avoid placing any *strict* reliance, for purposes of judgment, on the standards of purity which have been published in the treatise on "Water Analysis," by Wanklyn, and quoted in a number of recent works on Hygiene. It is impossible to lay down exact standards, or rules for judgment, which will hold good for

---

* Abstracts of lectures delivered before the Franklin Institute, December, 1880, in which additional original matter has been introduced. From the *Journal of the Franklin Institute*, February, 1881.

all countries and all localities in any one country. Such "standards" are, as Professor Nichols observes, only of relative value, and different kinds of water cannot be judged by the same standard.*

We must first of all discover, by numerous and carefully selected analyses, what are the chemical characteristics of good wholesome water in any given locality. These data then form a standard of purity for all waters of one kind within that particular district. A general knowledge of the geological and mineralogical character of the soil and rock of that region is an important factor in such a standard. A knowledge of the chemical character of the ground-water of the district, entirely free from any artificial conditions, such as polluted soil, is necessary for judgment of the well waters of the same district.

As regards different kinds of waters we must distinguish between

I. Ground waters, which include shallow well waters.

II. Deep well waters, including artesian wells.

III. Surface waters, such as rivers, streams, lakes, and ponds.

These three classes have essentially different characteristics, and one should not be compared with another without making proper allowances for these differences. It is thus incorrect to compare well waters near Philadelphia directly with the water of the Schuylkill river, as is sometimes done.

Upon reflection it will be readily understood that well waters are not commonly subjected to the oxidising influences to which river waters are so freely exposed, such as direct sunshine, air in motion over the surface, and aëration due to falls and currents in the river. Some mineral salts from factory refuse, from coal mines, &c., have possibly a modifying influence which is absent in the case of wells. Now there is a general feeling, among the medical profession and sanitarians, that organic matter which is more liable to rapid decomposition is more dangerous to health than more stable organic substances. In river waters there are greater chances for this decomposition to have been completed, leaving such substances as may be of the latter class in much greater proportion.

Hence, a larger amount of organic matter will be allowable in river water in the condition used for drinking than in well waters, provided that the supply is taken at a sufficient distance from the places where polluting material enters the stream.

Another point of importance in forming an opinion on the wholesomeness of a surface water is the natural character of its source. A river water which originates in peat bogs, or the tributary streams of which pass through a peaty district, will contain extract of peat in solution throughout its whole course. These waters certainly should not be compared, without qualification, with river waters which do not come in contact with peat, but nevertheless yield on analysis an equivalent amount of albuminoid ammonia derived from sewage contamination.

Thus, for instance, the water of Lake Cochituate, one of the sources of supply for Boston, probably contains considerable extract of peat, or other "vegetable extractive matter," which is, so far as we know, perfectly harmless in drinking water. So, also, is this the case, I believe, with the water of Jamaica Pond, which also supplies a part of Boston. Now, the Schuylkill river water supplied to Germantown, and taken from the river at Flat Rock dam, pumped at the Roxborough Water Works of Philadelphia, gave, according to my own analysis, during the the winter and summer of 1878, almost exactly the same results as Professor Nichols's analysis of the Cochituate and Jamaica Pond waters in 1873 and 1875 respectively, and with the same degree of variation at different times. But, while the analytical results are the same in both cases, a comparison of the general characters and sources of these waters convinces me that we cannot call the Germantown supply nearly so pure from objectionable organic matter as the Boston water. I think we may safely say that the Schuylkill contains no extract of peat, and the albuminoid ammonia undoubtedly comes from material which is far more objectionable. At times, also, since 1878, this albuminoid ammonia is as much as one-half greater than the largest amount from the Cochituate water in 1873, as supplied at the Massachusetts Institute of Technology, and nearly twice as great as the average amount of the latter. At such times the water has a perceptibly disagreeable taste and a slight odour, and this occurs usually when the water in the river is very low from drought.

In general, it may be said to be very necessary to know the exact source of any water submitted for analysis, the physiographical and geological characteristics of the locality from which it comes, and the location of any sources of pollution, such as cesspools, privies, drains, or sewers near the place of water supply. Whatever method of analysis is used, or in whatever way performed, the necessity of a knowledge of the previous history of the water is not diminished. Even with this knowledge, as is stated by Prof. Nichols, cases may arise in which an experienced chemist will be unable to give a decided opinion.

When the river water is pumped up into distributing reservoirs, the water from near the surface, and at the bottom of these reservoirs, should be submitted to analysis, to as to locate more accurately any trouble which may exist.

Furthermore, attention should be especially called to the fact previously referred to in this paper, that it is probably not so much the question as to how much organic matter, *per se*, may be consumed without danger in our drinking water. This point does enter, it is true, into the consideration. But it is *mainly* a question as to whether there is any danger of the water being contaminated with fæcal discharges from human beings suffering from infectious disease. It has been found that water containing so large a proportion of organic matter as to be called "loaded" with it may be drunk with impunity by some persons, or at least without any disastrous result being apparent for a long time; provided it does not also contain the "contagium" or unknown "something," whatever it may be, which will of itself develop specific disease. As soon as this "something" appears to be added by a previously diseased person an epidemic of this disease breaks out among those who consumed the water and who, until this time, remained apparently healthy.

Inasmuch as we have no means whatever of discovering the presence of this "contagium" because we know nothing of its character, any contamination with sewage is dangerous in proportion to its amount, and to the nearness of the pollution in time and place. Some authorities in Holland were once asked how much organic matter was allowable in drinking water without danger, to which they replied that drinking water should be, like Cæsar's wife, above suspicion. It may be laid down as a positive rule that a suspicious water is always a dangerous water.

The extent of dilution of the sewage in a river with a large body of moving water of good quality is undoubtedly an important factor, but this may be entirely counterbalanced by the fact of the water supply being taken very near a large sewer.

Upon these considerations lies the importance of the estimation of the nitrates and nitrites in a drinking water. These salts are among the results of the decomposition of organic nitrogenous matter, and are hence an evidence of what was either previously contained in the water, or which became oxidised by filtration through soil or by other means of decomposition before it reached the water. The greater the amount of nitrates above the natural limit, the larger the amount of organic material which has hitherto undergone oxidation, and hence the greater the danger, in the case of wells, of the soil becoming saturated and clogged with organic substance until a part of it will

---

* Prof. W. R. Nichols's paper on "Drinking Water and Public Water Supplies," in Dr. Buck's "Hygiene," vol. i, page 303.

escape filtration and pass unchanged into the water. Moreover, this part, which has escaped oxidation, may contain, for aught we know, the poison of a specific disease. Hence, it is important in order to form a correct opinion of the sanitary character of a well water, never to omit the proper tests for nitrates and nitrites, unless all the other quantitative tests concur in pronouncing the water pure. If any one of these gives a doubtful answer, the nitrates should always be tested for, and if more than traces are present, it will be best to make a quantitative estimation of them. It is true that nitrate may, probably, also result from reduction of the true ammonia, but this fact does not render the estimation any the less important, for this ammonia itself, under ordinary circumstances, results from the decomposition of the organic matter, and in shallow wells is usually regarded as evidence of pollution with urine.

We should remember, however, that deep wells may furnish a very pure water, containing very little organic matter, but large quantities of free ammonia, chlorides, and nitrates, all present in the same sample, which are derived from certain kinds of soil, such as the sand beds beneath the London clay and about 250 feet below the surface.*

Mr. Ekin† considers it necessary to estimate the amount of nitrates and nitrites in every instance, and states that a small increase in their amount should materially influence the judgment to be given. He states that he has been forced to this conclusion by facts ascertained in the course of his somewhat wide experience in the analysis of about 2000 samples of water, many of which were directly connected with cases of typhoid fever.

The estimation of nitrates, &c., in a river water, however, has manifestly not the same significance which it possesses in the case of well waters, on account of the superior influences effecting oxidation in the former, and the probable absorption of nitrates by aquatic plants. As regards *nitrites*, it is stated that delicate tests have not revealed their presence in the Thames river water.

In partial corroboration of the opinions of Mr. Ekin and Dr. Fox, as to the necessity of the estimation of nitrates, I will contribute a case in my own experience. I refer to the epidemic of typhoid fever in Spring Alley, or Royal Street, in the southernmost part of Germantown, which occurred last summer during the last week of July and first of August. There were upwards of forty cases, including four which proved fatal; and all, except one, were grouped in the immediate neighbourhood of a well situated at the intersection of two narrow streets. This well, known as the Spring Alley well, has had a wide reputation as a remarkably strong pure spring for, it is said, nearly a century. It is also said that typhoid fever never occurred in this locality before 1880. The well is only ten feet deep, the ground slopes down towards it from three sides, and a brick sewer passes within about ten feet of it, at about the same depth and having two badly choked up inlets directly opposite the well. An overflow drain connected the well directy with the sewer, *entering the latter near the bottom* at a short distance beyond the well. On the 5th of July a very heavy rain occurred, which deluged the vicinity of the well. As the sewer has, at this place, scarcely any fall it must have become suddenly clogged up with filth, and backwater must have occurred through the overflow drain directly into the well, polluting it, no doubt, to a very great degree. It was subsequently found by Dr. A. F. Müller, of Germantown, that a case of typhoid fever, probably imported from elsewhere, had occurred in a neighbouring house about six week before the heavy rain, and that the drain from this house connected with the sewer above the well. There were also other circumstances probably contributing to the pollution of this well. Another well, frightfully foul, but in no way connected with the sewer, being on higher ground, and the sewer lying between the two wells, increased, no doubt, the malignity of the epidemic. All the cases of fever developed at nearly the same time. The exceptional one, before mentioned, which did not occur close to the well, but at a house two blocks distant, was a child in a family who had sent to the first mentioned well for water, shortly after the pollution took place. All the people of the locality, and especially all those who had the fever, had used the Spring Alley Well, some of them continued to do so after the fever broke out, some had also used the water of the other well, but none had used the city from the Schuylkill until after the outbreak.

The chain of evidence thus seems unusually strong and clear. My analyses of this well-water were made during the prevalence of the epidemic and while new cases were developing. They are as follows:—

		I.	II.	III.	IV.
Free ammonia	Pts. per mil.	0·034	0·010	0·010	0·058
Albuminoid ammonia	,,	0·116	0·080	0·090	0·140
Chlorine	Grs. per imp. gal.	2·3	2·6	2·3	2·4
Total solids	,, ,,	30·5	—	—	28·0
Nitrogen as nitrates and nitrites,	Grs. per imp. gal.	—	1·94	—	2·45
Nitrogen as nitrites only	do.	—	0·096	—	0·032

The samples were collected in the order of the numbers respectively, Aug. 10, 12, 13, and 21; the last three early in the morning and the first at noon. No. II. was taken nine hours after a heavy rainfall lasting one and a half hours. No. IV. was collected half an hour after a short but heavy shower. The water, nevertheless, remained quite clear. All the samples were bright and colourless, with no odour, and having a refreshing taste. The water was quite hard.

In order to judge properly of these analyses, I give, for the sake of comparison, analyses of a hard and of a soft water which are typical of the purest well-waters in Germantown and perfectly free from contamination:—

	Free NH_3.	Albuminoid, NH_3.	Chlorine.	Solids
Hard water ..	0·010	0·050	2 2	34·0
Soft water ..	0·014	0·034	0·7	6·0

The hardness in Germantown waters is due chiefly to sulphates. It will be noticed that the chlorine in the Spring Alley well-water was not greater than is usual in pure hard waters here. What is still more remarkable is that the other well in Spring Alley contained not a particle more chlorine, notwithstanding that enormous amounts of free ammonia (from 2 7 to 5·2 parts per million) were present, with large excess of albuminoid ammonia, and large amounts of nitrates and considerable nitrite. In these two cases, therefore, *freedom from excess of chlorine did not prove freedom from contamination by sewage*, according to the rule usually stated. Three privies stood close to the second well, hence the chlorine test was of no value at all in this latter case. It may be added that the test was repeatedly made with the same result.

The following well-waters of Germantown, which I analysed in 1878, are examples of what we may find in wells in highly dangerous situations, which tend to confirm Mr. Ekin's statement, that dangerous wells may contain a small amount of organic matter along with considerable nitrate, and that in such cases the opinion to be rendered will depend very much on the presence of the latter:—

		I.	II.	III.
Free ammonia	Parts per mil.	0·040	0·022	0·016
Albuminoid ammonia	,, ,,	0·046	0·058	0·080
Chlorine ..	Grs. per imp. gal.	3·2	3·2	2·7
Nitrates		considerable.		large am't
Nitrites		traces	—	—

Hardness in all these waters, about 12°, due to sulphates chiefly. The situation of the wells is as follows:—No. I., Mechanic Street west of Morton Street, in close proximity

---

* Dr. Cornelius B. Fox. "Sanitary Examinations." p. 140.

† "Potable Water. How to Form a Judgment on the Suitableness of Water for Drinking Purposes." By Chas. Ekin, F.C.S. London: 1880.

to a number of privies which are on somewhat lower ground; soil—loose, micaceous sand. No. II., Haines Street, near M. E. Church; pump on street pavement, exposed to infiltration from gutter, &c. No. III., Haines Street, east of Hancock Street; well under kitchen porch. The owner felt anxious about it, and asked to have the water analysed. I have not heard of any sickness having been attributed to any of these wells.

The chlorine is very slightly in excess of the amount frequently found in pure hard waters of this district, and it would therefore by itself scarcely be considered a suspicious circumstance.

I will conclude this paper with the analysis by Professor Nichols of a well-water in Fairhaven, Massachusetts, published in the Massachusetts State Board of Health Report for 1879, which will be interesting in comparison with the foregoing analyses. It should also be stated that my analyses have shown that many other wells in Germantown are *far more polluted* than this one, particularly those in crowded localities.

Well in Fairhaven, Massachusetts.

Free ammonia	0·01	part per million.
Albuminoid ammonia ..	0·13	,, ,,
Chlorine	3·3	,, 100,000.
Total solids	20·3	,, ,,
Nitrates	Not in larger amount.	

The privy vault was *one hundred feet* distant from the well. The soil was composed of gravel and loam. On the 7th of September the husband was taken quite ill with typhoid fever, and his dejections passed freely into the privy vault. On September 30, and during the next twelve days, his wife and six children were successively taken with typhoid fever, and another child took the same disease a few days later. Thus, every member of this one family who had used the water of the well were ill with typhoid fever. The water was probably poisoned by the excreta of the husband, and the usual incubative period intervened before the disease appeared amongst the rest of the family. The chlorine in the water was found to be one part per one hundred thousand, more than the natural amount for that locality. In order to compare it with that in the other analyses given above, multiply by 7-10ths to reduce to grains per imperial gallon. The date of the analysis was October 17, within a day or two of the development of the last case of fever.

NOTICES OF BOOKS.

The Fields of Great Britain. A Text-Book of Agriculture. Adapted to the Syllabus of the Science and Art Department, South Kensington, by Hugh Clements, with an Introduction by H. Kains Jackson. London: Crosby Lockwood and Co.

The introduction to this little work is not cheerful. "All classes," we are told, "are being shifted to a lower level as regards income. The world demands more work and time for money than was accepted in the early half of the present decade." This, we submit, is cold comfort for an already over-worked world. If it be true that human improvement demands prolonged concentrated thought, and that such thought requires leisure, there is here unfolded the prospect of a cessation of that progress in science and its applications which has been the boast of the earlier half of the present century.

This treatise is not confined to agricultural chemistry, but treats of soils and their formation, minerals, elements and their compounds, climatology, the distribution of vegetable species, drainage, implements and machines, farm-buildings, malting, hay-making, stock, and in short everything which an agricultural student may be expected to know, or at least to pass an examination in.

On the distribution of plants we find some peculiar statements. We read (p. 50) that "prickly shrubs and scanty grass are peculiar to Central Asia." We think the author, if he should ever visit certain districts of Australia and South Africa would find palpable proof that this assertion is too sweeping. Neither can we admit that dates are peculiar to Arabia or the palm to India. On the following page we read:—"The arctic, sub-arctic, cold temperate, warm temperate, sub-tropical, tropical, and equatorial regions, roughly correspond with (1) lichens and mosses; (2) birch, fir, and pine; (3) oak, wheat, and deciduous trees; (4) wine-grape (!), evergreen trees, &c.; (5) laurels, myrtles, coffee, sugar-cane, &c.; (6) fig, olive, tree-ferns; (7) palms, spices, and bananas. It seems to us that the groups 5 and 6 have been inverted. The fig, olive, and the tree-ferns certainly flourish farther from the equator than do coffee and the sugar-cane. On the same page we find an account of the climatic conditions suitable for wheat, which is almost identically repeated on p. 53.

Of sewage irrigation the author speaks, in our opinion, somewhat too favourably. He says, "the milk obtained from sewage grass has been found to be treble that from the unsewaged." But has he compared the qualities, and above all the respective keeping-powers?

Peruvian guano, we are told, yields about 16 per cent of ammonia, but this sometimes falls as low as 12 and even 9. We fear that latterly a cargo containing 16 per cent of ammonia could no longer be met with. The subject of the diseases and the enemies of our field- and garden-produce seems too slightly touched upon.

In the chapter on malting the author shows that this process does not increase the nutritive power of grain. Lucerne and sainfoin are described twice, p. 61 and again on p. 159. On p. 50 the fig is said to be peculiar to Arabia, but on p. 184 it is pronounced to be "a native of Asia, especially India." The author's remarks on the cultivation of fruits and the desirability of its increase in this country are timely and judicious. The same must be said of the section on the growth of forest-trees. In our weeping climate, indeed, we need not fear drought as a possible result of the deficiency of trees, but an increased amount of planting would reduce the sweep of the wind, which is one of the worst enemies of the farmer and the gardener.

Under the head "Food" we are told, "organic bodies are *sharply* divided into plants and animals." We must remind the author that according to eminent modern authorities it is often in individual cases extremely difficult to come to a decision as to the kingdom to which a given organism should be referred, and in many cases the determination is purely arbitrary.

Mr. Clements justly regrets the little attention paid to poultry in England, and the consequent necessity for the importation of large quantities of eggs. At the same time we must remember that the dampness of our climate is a drawback as regards the common fowl, and still more so in case of the turkey.

We are somewhat surprised at finding in this work so little reference to the diseases of cattle, and especially the epidemics that have of late years wrought so much havoc, as well as the prospect of checking these evils, which has been opened out by the researches of M. Pasteur.

The work before us must be pronounced, as a whole, useful and valuable, though we must express the hope that the author, in the very probable case of a new edition, will re-consider the passages to which we have felt it our duty to take exception.

Electro-typing: A Practical Manual, forming a New and Systematic Guide to the Reproduction and Multiplication of Printing Surfaces and Works of Art by the Electro-Deposition of Metals." By J. W. Urquhart, C.E. London: Crosby Lockwood and Co.

The time has altered since the earliest manuals of electro-metallurgy appeared. What was then one novel art has grown into two distinct branches—electro-plating and electro-typing. The former term as now employed is restricted to the deposition of a thin coat of some more valuable metal upon a metallic article for the purpose of ornament, or of preservation from corrosion. The electrotypist seeks to produce a distinct and separate object, which when complete is removed from the mould upon which it has been deposited.

In the work before us the author enters systematically and thoroughly into every department of the process, in the style of one who combines theory with practice.

At the outset he gives the nomenclature of the art, explaining what is meant by electrolysis, electrodes, ions, the ohm, farad, weber, and volt, and giving an account of the electric circuit, of conductors, insulators, currents, and electromotive forces. The difficulties due to polarisation in the battery and in the depositing cell are touched upon. The author then treats of the decomposition of different solutions, showing how to find the electric equivalent of a metal by dividing the atomic weight by the valency. He then passes to the relation of current to work, the effects of large and small electrodes, and the resistance of the solutions. The second chapter treats of the metals used in electro-typing.

In the third chapter we find an account of the available sources of electricity. Where there is abundance of regular work he gives the preference as regards economy to a dynamo-electric machine, such as those of Gramme, Wilde, or Siemens, the two former of which are here figured.

Thermo-electric batteries, such as that of Clamond, the author considers to be a cleaner and cheaper source of electricity than the galvanic batteries, but they have scarcely received fair play at the hands of the trade. Among galvanic batteries he thinks the Daniell and the carbon-and-zinc bichromate cells decidedly less costly than the Smee. For the measurement of current—a point very generally determined by guess or by rule of thumb—he recommends Sprague's galvanometer. The following chapters are devoted to a very thorough consideration of the solutions, the depositing vessels, the moulding materials, the preparation of the work, the depositing process. We can recommend this treatise not merely to amateurs but to those actually engaged in the trade, many of whom are content to pursue blindly the routine they have once for all learnt without caring to understand the principles of the art. We are convinced that Mr. Urquhart points the way to many improvements of too much value to be overlooked.

Lehrbuch der Organischen Qualitativen Analyse. (Manual of Organic Qualitative Analysis). Part II. By Von Dr. Chr. Th. Barfoed. Kopenhagen: A. F. Höst and Sohn.

In this second part of his manual, Dr. Barfoed continues instructions for the recognition of the saccharine bodies, cane-sugar, grape-sugar, and milk-sugar. He then passes over to the gums, dextrin, arabin, cerasin, bassorin, vegetable mucus, and pectin. It will be at once perceived that not a few organic bodies, occurring in nature and liable to be met with in vegetable mixtures, are here omitted. The author next proceeds to the consideration of the neutral fats. After those which yield glycerin on treatment with alkalies he describes spermaceti and wax, followed by a closer examination of glycerin. In all these cases directions are given for recognising the substance in question when accompanied by bodies which disguise its properties. Thus we find instructions for the detection of neutral fats or free fatty acids in presence of soap; for mixtures of glycerin with sugar and glucose, &c. The resins and gum-resins are described at some length. The author remarks that the detection of the various resins when presented separately is not difficult. In the state of mixed powders it is less easy, and still less so if they have been melted together. In this case little more can be done than to put on record their behaviour in boiling water, their fusibility, their solubility in alcohol, ether, the alkalies, &c. Under the volatile oils we do not find the characteristic reactions of each specified. There are, however, general directions for the examination of these bodies, either alone or when mixed with resins, fats, soaps, gum, sugar, &c. The next section treats of the recognition of ordinary alcohol in various mixtures, *e.g.*, with acids, alkalies, volatile oils, &c. We then come to ordinary ether, its compounds, chloroform, and chloral. We regret that methylic alcohol, a compound so abundantly used in the arts, has not been made the subject of a section.

We come now to the albumenoids. Prof. Barfoed describes specially the properties of albumen, casein, fibrin, glutin, hæmoglobin, and gelatin.

So far as the author has gone we consider its teachings sound and trustworthy, but we see no valid reason for the omission of many bodies of considerable importance.

CORRESPONDENCE.

THE SOCIETY OF CHEMICAL INDUSTRY.

To the Editor of the Chemical News.

Sir,—Referring to the formation of the Society of Chemical Industry, an account of which appeared in your last issue (Chemical News, vol. xliii., p. 164, may I suggest through your columns one way in which such a Society may, in my opinion, greatly benefit our chemical industries? viz., by the establishment of a well-organised School of Chemical Technology, wherein students may be thoroughly instructed in the technical details of processes involved in the application of Chemistry to the Arts and Manufactures, and be shown how to bring to bear upon such processes a knowledge of engineering and building, and other constructive details required in arranging Works and constructing apparatus. The chemical education afforded in this country, excellent as it is in such schools as Owens College, laboratories at South Kensington, and elsewhere, does not, as it appears to me, sufficiently deal with truly technical details; and if the new Society—dealing, as I understand it is intended it should deal, with really technical matters—can see its way to the establishment of a really efficient School of Chemical Technology, then it will do work not only of immense benefit to the chemical industries of this country, but of world-wide importance.

Another field of usefulness for such a Society seems to me to be the collection and systematic arrangement of all information of importance to our chemical manufactures, so as to form as complete a library as possible of Chemical Technology.—I am, &c.,

A. Norman Tate.

Analytical Laboratory and School of Technical Chemistry,
7, 8, 9, and 11, Hackin's Hey, Liverpool,
April 12, 1881.

THE SOCIETY OF CHEMICAL INDUSTRY.

To the Editor of the Chemical News.

Sir,—Pray how far is the subdivision of chemical society to be carried? Perhaps as far as Scotch theological society, regarding which, if my memory serve me rightly, the following is told:—In a certain district the various sections had divided and subdivided, and divided again. At last the "true Kirk" was supposed, by its members, to be represented by only two individuals, a man and his wife, "and," said the latter, "I'm no that sure of e'en Jamie."

We have the Institute, the Chemical Society, the Pharmaceutical Society and Conference, the Society of Public

Analysts. To these is now to be added a Society of Chemical Industry.

I believe that much of this division is utterly unnecessary, and very expensive to a body of men not—as a rule—too well off. I cannot conceive why this last Society should not form a section of the Institute, if the Chemical is too purely scientific, the Pharmaceutical too much devoted to pharmacy, and the Public Analysts too much interested in mere analysis. It is difficult enough now to get a decent meeting of the Institute; it will be doubly so if chemists are called upon to attend other meetings.

But if the promoters of this Society wish to include in it some who, though not strictly chemists, yet are interested in chemistry, why should they not endeavour to form a technical section of the Chemical Society, with a night for meeting distinct from the scientific night?—I am, &c.,

F.I.C., F.C.S.

BENZOL TESTING.

To the Editor of the Chemical News.

Sir,—The cause of scientific accuracy is not to be advanced by unjust criticism, though it has been, and will continue to be, advanced by just criticism, however severe.

Your correspondent William Thomson has unintentionally misconstrued the statements made by me in a previous letter (Chemical News, vol. xliii., p. 115). In the first place, he states—"Mr. Staveley says that he distilled a sample of benzol, *and did not allow the temperature to rise above* 97° C., and he obtained 37 per cent distillate." What I did state was—"Wishing to give his (Mr. Thomson's) apparatus a trial, I, by means of a copper water-bath and retort, fitted up a similar apparatus, and placed in the retort 100 c.c. of 30 per cent benzol. . . . After the water in the copper bath had been boiling about one and a half hours 37 per cent distillate was recorded, *whilst the thermometer on the retort had not registered more than* 97° C."

Mr. Thomson also says that "he (Mr. Staveley) says such differences as three-eighths of an inch and one inch on thermometer bulbs do not exist." Whereas my statement was—"The thermometers used in various parts of the country for benzol testing vary but slightly, and in no instance would there be such a difference as one inch and three-eighths of an inch."

On such misconstructions Mr. Thomson bases his arguments. To such an unfair criticism I shall not attempt to reply except to say that the whole of my statements are based on many years' experience in a large benzol refinery.

In conclusion I should be pleased to correspond with "J. D." and "Country Tar Distiller," in whose last letter I am much interested. With a view to making a series of experiments to determine the influence of barometric pressure, &c., on the results of benzol tests, the whole question could then be discussed, say, at an early meeting of the new "Society of Chemical Industry,"—a Society which I believe will do much towards lessening the number of disputes occurring in all branches of chemical industry, by the formation of Boards of Arbitration consisting of chemical "*Specialists*."—I am, &c.,

William W. Staveley.

West Bromwich.

BENZOL TESTING.

To the Editor of the Chemical News.

Sir,—To assist to some extent in eliciting information on this subject, I some weeks ago gave you the result of my experience as to the effect of barometric pressure on the benzols which have passsd through my hands during a number of years. These have been Scotch benzols **only**; and from what was said by one of your correspondents, whose experience, on the other hand, seemed to refer to English make of benzol, the difference in our results pointed in my mind strongly to a solution of the question both as to English and Scotch, or in fact to any make, whatever the specific gravity might be. In the meantime allow me to confirm what I said as to the effect of barometric pressure on the benzols which have passed through my hands, these being, as I have said, Scotch make, and of a specific gravity of about 866° in the case of 30 per cent. In fact I then rather under than overstated the effect of pressure.

After reading your correspondent's letter referred to, I procured a sample of English make having a specific gravity of 873·6, and tested it for the quantity of distillate at 100° C. with my usual apparatus. It gave 35 per cent, the barometer indicating 29·9; and afterwards, by means of an air-pump attached to the retort, another portion of same sample was tried under a steady pressure of 28·9, and it then gave 39 per cent. From these two experiments it would not be wise to attempt to form rules for testing; but from these and other matters connected with the subject which have come under my observation, I am confident that on that line of investigation will be found a mode of procedure applicable to all makes of 30 per cent and 50 per cent benzols; and to endeavour to bring out of this correspondence a practical result I would suggest that a competent analyst be appointed by the tar distillers interested, who, with information gathered from various testers, should not have much difficulty in giving us a fixed and satisfactory mode of testing which would be applicable to all benzols and under all states of the atmosphere. In the meantime, and until some universal system is adopted, I intend to continue testing as hitherto, and with the same apparatus I have always used, but in all cases will first of all take the specific gravity, and if in the case of 30 per cent it is 866° (our usual sp. gr.) will allow 0·8 per cent for every tenth of mercury above or below 30 inches (this standard I think, however, too high); but if the specific gravity reaches 870°, which it has on one or two occasions, I will then allow only 0·6 per cent, and so on in proportion to the specific gravity.

The points I would like to see determined by an analyst of authority are—the effect of atmospheric pressure in relation to specific gravity (this should be particularly observed, and a table formed for reference), capacity and form of retort, length and diameter of tube of Liebig's condenser, form of tube at outlet, number of drops of distillate per minute, quantity of liquid to be used in testing, diameter of receiving vessel, length of stem and form of bulb of thermometer, and the mode of applying the heat. I may mention that I use an arrangement by means of which the bottom only of the retort is heated.

Referring to a remark made by one of your correspondents, I have repeatedly tested the same sample of 30 per cent benzol under the same conditions of barometric pressure, apparatus, and rate of boiling, and always got an uniform result.—I am, &c.,

J. D.

ESTIMATION OF PHOSPHORUS IN STEEL.

To the Editor of the Chemical News.

Sir,—In your issue of the 1st inst. (Chemical News, vol. xliii., p. 147) there appeared a paper by Mr. J. Oliver Arnold, F.C.S., detailing some experiments on which the author bases a very sweeping condemnation of the method of estimating phosphorus originally described by Eggertz. As it is but too often the case that conclusions against which no protest is made are swallowed whole by the too credulous, I propose to point out certain respects in which Mr. Arnold's results and conclusions are open to curious exception.

To prove the accuracy of the magnesia method Mr. Arnold adopts the astonishing device of adding a weighed amount of magnesium pyrophosphate to the steel, and then proceeding as before. Without knowing at what stage he added the pyrophosphate, it is not possible to estimate the chances of its undergoing conversion to orthophosphate, but for the same reason the value of the results is very slight.

Without going in detail into Mr. Arnold's results, almost all of which, however, are open to exception, I may point out that the low results he obtained by the molybdate process are clearly due to inattention to several conditions which are well known to be important in the attainment of success. Thus—

1. Mr. Arnold used "a moderate excess" of the molybdate solution, whereas every tyro knows that the presence of a very *large* excess is important, if not essential.
2. Mr. Arnold manipulated in presence of ferric chloride and some free hydrochloric acid, whereas careful operators get rid of all chlorides by evaporating several times to a low bulk with nitric acid.
3. Mr. Arnold allowed only "an hour or two" for the formation of the yellow precipitate, instead of the much longer time commonly regarded as requisite in the absence of a "hastener."

It appears, therefore, that Mr. Arnold neglected three of the most important conditions of success, and this in a series of experiments intended to test the value of the method.

Mr. Arnold proposes to do what so many chemists whose experience of phosphoric acid determinations is limited to agricultural products have thought possible,—namely, to precipitate the phosphorus by molybdate, redissolve in ammonia, and precipitate by magnesia mixture. Magnesium pyrophosphate contains 27·93 per cent of phosphorus, whereas the molybdate precipitate contains only 1·63 per cent. Mr. Arnold, in his six test experiments by the magnesia process, obtained a mean weight of 13·9 m.grms. of pyrophosphate. If he had weighed the corresponding amount of phosphorus as the molybdate precipitate he would have obtained 234·9 m.grms. Conversely, by his suggested modified plans, he would redissolve 234·9 m.grms. of yellow precipitate in order to convert it into 13·9 m.grms. of magnesium pyrophosphate! And this is done for the purpose of getting a more accurate result! If it be admitted, which it is now almost universally, that the composition of the yellow precipitate is practically constant if it be produced under the same general conditions, what possible advantage can there be in its re-solution? Of course I am here referring to determinations of phosphorus in steel, for I doubt whether the composition of the precipitate is so constant as to render the weighing safe when large percentages of phosphorus are to be determined. Suppose that the amount of yellow precipitate which *ought* to be obtained from 5 grms. of a given steel is 200 m.grms., but that, from various causes, the weights actually obtained in two experiments were 195 and 205 m.grms., then the true and observed percentages of phosphorus will be as follows:—

	True.	Experiment.	
		I.	II.
Phosphorus per cent ..	0·0652	0·0636	0·0668

In other words, a variation of 5 per cent in the weight of the molybdate precipitate produces a perfectly insignificant effect on the proportion of phosphorus reported, whereas the small proportional variation in the weight of the magnesium pyrophosphate would be much more serious.

Though not admitting the accuracy of most of Mr. Arnold's conclusions, I think his contribution fully justifies him in his assertion that many estimations of phosphorus carried out in the laboratories of iron and steel works are utterly unreliable.

As arguments do not depend for their cogency on the identity of their employer, I prefer to sign myself,—Yours, &c.,

Phosphorus.

April 11, 1881.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Moniteur Scientifique, Quesneville.
November, 1880.

Heat of Combustion and of the Formation of Organic Compounds, according to the Rational Formulæ.—G. Quesneville.—Setting out with the simple hypothesis that to remove a radicle from a centre of attraction, it is necessary to effect a certain work measured by a number of great calories proportional to the molecular weight of such radicle, the author has been able to calculate the heats of combustion and of formation for all organic compounds whose chemical syntheses have enabled their rational formulæ to be detected. The heat of formation is proportional to the molecular weight: $Q = pT$. If the compound is formed (as in ethylene) of simple radicles, C, H, and an atom of carbon plays the part of the centre of attraction, we have $Q = (C + 4H).T$, the value of Q being given by the second relation $Q = \Delta$, whence we infer $T = \Delta : (C + 4H)$. For ethylene we have $\Delta = -15{\cdot}4$ and $C + 4H = 16$, whence $T = -1$ approximately, which if substituted in the fundamental equation, gives the heat of combustion 342, verified by experiment 341·4. In these, expression T is the work, estimated in calories corresponding to the displacement of the unity of weight. Tp is the work corresponding to the displacement of a radicle of the molecular weight p. The author represents by Δ the heat of the formation of a compound from its elements, *i.e.*, the difference between the sum total of the heats of combustion of the elements and the heat of the combustion of the compound, identical products being formed. Such difference should represent in calories the sum of all the work, which in the case of marsh-gas is obtained by grouping the elements C, H, H, H. On calculating such works separately we obtain in calories a number Q, which must be, if the hypothesis is correct, precisely equal to the difference Δ.

Academy of Medicine.—At the meeting of the 12th October, during the adjourned discussion on the "cholera of poultry," the animosity between M. Pasteur and M. Jules Guérin reached such a height that they had to be forcibly kept asunder. What renders this scene the more deplorable is that M. Guérin is 84 years of age and M. Pasteur is paralysed on one side of his body!

The Odours of Paris.—A long report on the sanitary condition of Paris and the means proposed for its improvement. It is remarked that a proposal has been made to extend irrigation works to Saint Germain and other suburban communes. But sufficient attention has not been given to the extent of irrigation ground needful to utilise all the water. In fact 400,000 cubic metres daily represent 4600 litres per second, which in the south of France is enough to irrigate 4600 hectares, and there irrigation is only applied from April 1 to September 30. If sewage is to be poured upon the soil all the year double, perhaps triple, or quadruple, the surface will be required if the soil is not to be saturated and rendered unfit for crops. The author further asks, What is to be done in time of heavy rains and snows, when the flow of sewage is greatest and the soil least able to receive it?

Process for Rendering Tissues and Wood Uninflammable.—A. Martin.—Taken from the *Bulletin de la Société d'Encouragement.*

Determination of Nitrogen by Means of Soda-lime. MM. Gassend and Quantin.—The authors find sources of error in the weight of the sample taken for analysis and its percentage of nitrogen, in the length of the tube and the duration of the combustion, these two causes acting in the same direction. If the escape of bubbles is too slow, or if the tube is too long a greater or less proportion of the ammonia may be decomposed into nitrogen and hydrogen. The quantity of matter employed ought to be such that not more than half the standard acid may be saturated by the ammonia evolved. The combustion-tube should not exceed 40 centimetres in length, and the plug of asbestos should be from 3 to 4 centimetres.

Justus Liebig's Annalen der Chemie,
Heft 2, 1880.

Researches on the Magnitudes of the Affinities of Carbon.—This memoir consists of two sections, the first of which, by A. Geuther, treats on the conversion of chloro-carbonic acid into formic acid. The author remarks that the affinities of carbon may be resolved into two groups, which he names, respectively, carbonic oxide affinities and carbonic acid affinities. He raises the questions whether the affinities in each of these groups are equal or unequal among themselves, and whether those of each are equal or unequal to those of the other? His experiments show that chloro-carbonic acid can be converted into ordinary formic acid by the direct substitution of hydrogen for chlorine. The second part of the memoir by Dr. Bruno Röse on "New Carbonic Ethers," gives a reply to the first of these questions.

Chemisches Central-blatt.
No. 31, 1880.

Guthrie's Cryohydrates.—H. Offer.—The author thinks that the balance of probability is in favour of Pfaundler's view, viz., that these bodies are mechanical mixtures of salt and ice.

Propargylic Acid as a Decomposition-Product of Ethylen-dicarbonic Acid.—E. Bandrowsky.—Propargylic acid is a colourless liquid which smells of acetic acid, and assumes a dark colour on exposure to the air. It boils at 145° and congeals at −6°.

Journal für Praktische Chemie.
Parts 5 and 6, 1880.

The Cyanamide Compounds of Succinic Acid.—Dr. H. Möller.—Succinic acid forms with cyanamide three compounds corresponding to those formed with ammonia, succincyaminic acid, succincyanimide, and succincyamide. Succinic anhydride with potassium cyamide either in alcoholic or watery solution forms potassium succincyaminate. Succincyaminic acid, like succinamic acid, is easily decomposed. It is a strong bibasic acid, and forms two series of salts, among which the author describes those of potassium, barium, calcium, and silver. By the action of succinic acid chloride upon cyanamide in absolute ether, free from alcohol and water, there is formed succincyanimide along with cyanamide hydrochlorate. Succincyanimide, like succinimide, is decomposed by water into succincyaminic acid, and by alcohol into ether-succincyaminic acid. Sodium cyamide and ethyl oxide succinate in alcohol yield succincyamide sodium. Sodium cyamide and succinic acid chloride yield sodium chloride and sodium succincyamide. Succincyanimide melted with cyanamide yields succincyamide. This last-mentioned body is an acid and behaves more like cyanamide than succinamide.

Combustion-Heat of Organic Compounds (Continued from vol. 22, 1).—Dr. C. v. Rechenberg.—The author examines here the application of the heat of combustion to the explanation of chemical processes, and the liberation of heat during the hydrolytic transformation of the carbohydrates, which, like the transformation of cellulose, inuline, and metarabic acid into fermentible sugar, is always attended with the development of heat, and concludes that every fermentation is attended by this phenomenon. He points out that in certain isomeric groups the heat of combustion decreases as the melting-point rises, whilst the heat of formation increases, but the differences are so small as to fall within the limit of experimental error.

Determinations of Chemical Affinities.—Dr. W. Ostwald.—In this paper, which does not admit of useful abridgment, the author points out the hazard of employing the speed of reactions for the determination of affinity.

Cyanæthine and its New Basic Derivatives.—E. von Meyer.—Not adapted for abstraction.

Action of Hydrochloric Acid upon Organic Amides.—L. Schulerud.—Amido-benzoic acid, heated in a current of dry hydrochloric acid, yields water and ammonia, whilst a solid matter remains in the retort, probably a condensation-product.

MISCELLANEOUS.

Chemical Labels.—Messrs. Woolley, Sons, and Co., of Manchester, have sent us some sheets of chemical labels which are likely to be useful in Laboratories under the "Science and Art Department." Some, printed on white paper, every student is required to have on his working bench; while others, on red paper, are for general use in the Laboratory. It has been found that general reagents find their way, accidentally or through carelessness, amongst the students' reagents, thus causing loss of time to others who require them in discovering where they are. By printing the general reagents on red paper the student will immediately see, should he have a red label amongst his own reagents, that it is in its wrong place. The printing is bold and legible, the formula of each reagent is given, and the labels are gummed at the back.

MEETINGS FOR THE WEEK.

Monday, 25th.—Medical, 8.30.
—— Philosophical Club (Anniversary), 6.30.
Tuesday, 26th.—Civil Engineers, 8.
—— Medical and Chirurgical, 8.30.
—— Royal Institution, 3 p.m. "Non-Metallic Elements," Prof. Dewar.
Wednesday, 27th.—Society of Arts, 8. "Five Years' Practical Experience of the Working of the Trade Marks' Registration Acts," Edmund Johnson.
—— London Institution (Anniversary), 12 noon.
—— Geological, 8.
Thursday, 28th.—Royal, 4.30.
—— Royal Society Club, 6.30.
—— Royal Institution, 3. "Magnetism," Professor Tyndall.
—— Society of Arts, 8. "Impurities in Water, and their Influence upon its Domestic Utility," G. Stillingfleet Johnson, F.C.S.
Friday, 29th.—Royal Institution, 8. "Language and Literature of the Scottish Highlands," Prof. Blackie, 9.
—— Society of Arts, 8. "The Building Arts of India," General Maclagan, R.E.
Saturday, 30th.—Royal Institution, 3. "Scotland's Part in English Literature," Prof. Morley.

TO CORRESPONDENTS.

Carbide of Iron.—Wanted the address of a maker of commercia carbide of iron for filtering purposes.

THE CHEMICAL NEWS.

Vol. XLIII. No. 1118.

NOTES ON THE OXIDES OF MANGANESE.

By SPENCER UMFREVILLE PICKERING, B.A. Oxon, F.C.S.,
Assistant Master at Highgate School.

In a paper which appeared in the *Journal of the Chemical Society* for 1879 (p. 659), "On the Action of Hydrochloric Acid on Manganese Dioxide," I alluded to certain experiments which proved that some oxides of manganese, when heated in air to a temperature of 200° or even 100° C., experienced either a loss or gain of oxygen according to the amount of dioxide contained in them. It was intended that the interesting subject with which these experiments dealt should be thoroughly investigated and the results laid before the Chemical Society, but after about three week's further work (ending July 10th, 1879) the subject was found to be so much more complicated than had at first been anticipated, that time and means for its investigation were found wanting.

The experiments, such as they are, which will be described in the present paper, must be regarded simply as preliminary experiments—and, consequently, of a somewhat rough nature; indeed, they would not now be published did they not agree more or less with some results published by Wright and Menke in January, 1880, and others of a still more recent date published by Veley. They, however, contain also a few facts which have not hitherto been ascertained by these or other authors, which, if not thoroughly investigated here, may at any rate offer useful suggestions to those who intend to pursue the investigation of the manganese oxides any further.

§ I. *Oxides used.*

Two classes of manganese oxides were used in these experiments. (1) Impure, procured from Messrs. Hopkin and Williams, and prepared by means of sodium hypochlorite; (2) pure, obtained by the decomposition of an acid solution of manganese sesquichloride by an excess of water. The former of these (commercially known as "pure" oxides) contained a considerable amount of sodium and calcium salts, the calcium being derived from the undistilled water used in washing them,[*] but they contain no trace of iron or other heavy metal. From 65·53 to 32·07 per cent of the manganese contained in them was present in the state of dioxide (the rest being considered present as monoxide[†]). In order to prepare the second class of oxides, some of the impure samples were dissolved in the least possible amount of hydrochloric acid, the solution filtered, and poured into a large volume of a distilled water sufficient to effect the perfect decomposition of the manganese sesquichloride present, from 1 to 5 litres of water being used for each grm. of oxide thus precipitated. These oxides are absolutely pure, and contain no trace whatever of any foreign substances. About 1 grm. of each sample was dissolved in hydrochloric acid, ammonia added, and the manganese precipitated with hydrogen sulphide. On filtration and evaporation (all the operations being performed in platinum vessels), with the addition of a few drops of sulphuric acid, and subsequent ignition, there was in no case the slightest trace of residue obtained which was either weighable on a delicate balance or visible with the help of a strong magnifying lens. Hence in this way all the alkaline and earthy impurities present in the original oxide taken (amounting to as much as 7 or 8 per cent when calculated as hydrates), are entirely eliminated, and a perfectly pure oxide is obtained; this method appearing to be one of the few by which a pure highly oxidised *hydrated* oxide has been obtained.[*] These results are in opposition to those obtained by Wright and Menke (*Jour. Chem. Soc.*, 1880, p. 33), who found a very considerable amount of impurity in oxides prepared by this process. It is true that the original oxide with which Wright and Menke obtained their solution of the sesquichloride contained potassium, whereas mine contained calcium and sodium; this fact, however, can scarcely account for the difference in the results obtained, for they state that in the case of calcium, the tendency of manganese dioxide to carry down foreign metals in combination appears to be superior to its power of uniting similarly with potassium (*ibid.*, p. 23). These pure oxides used in the following experiments contained from 88·13 to 83·2 per cent of the total manganese present in the state of dioxide.

§III. *Method of Experimenting.*

In conducting these experiments, a weighed quantity of the oxide was placed in a watch-glass, amd heated in an ordinary copper air-bath till its weight remained constant; it was then heated again in the bath for about half-an-hour, and then while still hot thrown into an acidulated solution of potassium iodide, the liberated iodide being determined in the manner described and fully investigated in a previous paper (*Jour. Chem. Soc.*, 1880, p. 128). It could hardly have been expected that the temperatures recorded by a thermometer placed in a bath such as that used would have recorded with any accuracy the temperatures at which the oxides in the bath were really heated. Some experiments, however, which have been performed more lately, using a vapour-bath, and which will be specially noticed below, show that the temperatures here recorded cannot, in some cases at any rate, be very erroneous. In order to obtain concordant results it was found necessary always to place the watch-glass in the same position in the bath.

§ III. *Experiments with Impure Oxides.*

1. *Oxide No.* 1.—This was a sample of the so-called "pure manganese dioxide" procured from Messrs. Hopkin and Williams. A determination of the impurities present gave the following results:—

$Ca(OH)_2$	3·44	per cent
NaOH	4·16	,,
Total	7·60	,,

After deducting these impurities the composition of the oxide was[†]:—

MnO_2	55·396	per cent
MnO	24·910	,,
H_2O	19·694	,,

Whence we find the total manganese present to be 54·298 per cent, and—

$$\frac{\text{Mn as } MnO_2}{\text{Mn as } MnO} = \frac{65·53 \text{ per cent}}{34·47 \text{ per cent}} = 1·901.$$

The results obtained with this oxide are given at length in Table I. They show that even at the lowest temperature employed—namely, 100° C.—this oxide gains a very appreciable amount of oxygen corresponding to an increase

---

[*] Messrs. Hopkin and Williams now prepare their "pure manganese dioxide" by a different process, by which they obtain a purer, and at the same time a richer, substance.

[†] For the sake of simplicity all oxides will in this paper be considered as mixtures and compounds of the dioxide and protoxide.

[*] A pure non-hydrated oxide may be obtained by the ignition of the nitrate, but Wright and Menke failed to obtain a pure hydrated oxide either by the action of nitric acid, sulphuric acid, sulphur dioxide, alcohol or glycerin, or of manganese sulphate on potassium permanganate; or by the oxidation of manganous hydrate, which had been prepared by potash, in air; or by the addition of bromine to manganese chloride in the presence of potassium acetate (*loc. sup. cit.*) Veley obtained a pure hydrated oxide by passing chlorine into a solution of manganese acetate.

[†] These oxides were analysed in the manner described in a previous paper (*Chem. Soc. Jour.*, 1880, p. 659.)

of 1·37 per cent on the dioxide present before heating: this gain increases rapidly as the temperature rises, exceeding 10 per cent at 200° C. The results, when represented diagrammatically, form a curve of considerable uniformity.

Inasmuch as the operation of weighing a somewhat hygroscopic substance in a watch-glass does not admit of great accuracy, it was thought possible that a small gain of oxygen might take place by prolonged heating, even after any change in weight had ceased to be observed, the last eight experiments given in the table were peformed, and they show in this case that when the heating is prolonged beyond half an hour no further alteration takes place. In the case of all the other oxides investigated, from half-an-hour to one hour was found sufficient to complete whatever change they experienced, although, for the sake of greater security, the heating was in most experiments continued for two or three hours.

A few experiments performed with this oxide seemed to show that after it had been heated at the above-mentioned temperatures, and been made thus to absorb a considerable amount of oxygen, it did not evolve this oxygen on being exposed to air at ordinary temperatures. Similary, other oxides which lost oxygen on being heated remained unchanged at lower temperatures after that heating.

TABLE I.

Experiments on the Oxide No. 1.

Conditions of Expt.	Percentage of MnO_2 found, calculated on the unheated Oxide.			Percentage Increase in the MnO_2 present. P.c. gain.
Before heating—				
1.	55·449	55·396		
2.	55·480			
3.	55·360			
4.	55·267			
5.	55·397			
6.	55·432			
7.	55·478			
8.	55·306			
After heating—				
9. At 100°	56·233	56·152		1·37
10.	56·172			
11.	55·967			
12.	56·182			
13.	56·308			
14.	56·150			
15. At 168° C. ..	58·874			6·28
16. At 190° C. ..	60·191			8·656
17. At 200° C. ..	60·999	61·075		10·25
18.	61·071			
19.	61·514			
20.	60·815			
21.	61·026			
22.	61·128			
23.	60·972			
24. At 202° C. ..	61·534			11·08
25. At 203° C. ..	61·678	61·693		11·35
26.	61·708			
27. At 100° for ½ hr.	56·152	56·280	56·150	1·365
28.	56·408			
29. At 100° for 2 hrs.	55·967	56·012		
30.	56·057			
31. At 100° for 4 hrs.	56·151	56·304		
32.	56·457			
33. At 100° for 6 hrs.	56·116	56·004		
34.	56·992			

2. *Oxide No.* 2.—This oxide, like the previous one, was obtained from Messrs. Hopkin and Williams. It was, however, less rich in oxygen, and, deducting the 7 per cent of impurities which were present, its composition was found to be—

MnO_2	45·993	per cent
MnO	50·171	,,
H_2O	3·936	,,

And hence it contained 67·919 per cent of manganese, present in the following state of oxidation:—

$$\frac{\text{Mn as MnO}_2}{\text{Mn as MnO}_2} = \frac{42{\cdot}79 \text{ per cent}}{57{\cdot}21 \text{ per cent}} = 0{\cdot}748.$$

From the fact that this oxide contains considerably less oxygen than No. 1, it might have been anticipated that on being heated it would have taken up more oxygen than No. 1 did. So far, however, was this from being the case, that it was found not only to absorb no oxygen at all, but even to lose an appreciable amount at 100° C. and higher temperatures, as will be seen in Table II., where the experiments on this oxide are recorded. It will also be observed that the amount of change in composition is not increased by an increase of temperature to nearly such a great extent as in the case of No. I.

TABLE II.

Experiments on the Oxide No. 2.

Before heating—			
35.	45·991	45·993	
36.	45·996		
After heating—			
37. At 100° C. ..	45·626	45·687	0·665 p.c. loss
38.	45·747		
39. At 183° C. ..	45·494	45·526	1·015 p.c. loss
40.	45·526		

3. *Oxide No.* 3.—This oxide was prepared by the ignition of some of the first-mentioned specimen. In composition it approximated to Mn_3O_4, as is seen from the following analysis (the impurities present being deducted):—

MnO_2	37·467	per cent
MnO	61·875	,,
H_2O	0·650	,,

Whence the total manganese present was 71·464 per cent, and—

$$\frac{\text{Mn as MnO}_2}{\text{Mn as MnO}} = \frac{33{\cdot}07 \text{ per cent}}{66{\cdot}93 \text{ per cent}} = 0{\cdot}494$$

That this oxide should contain rather less oxygen than is required by the formula Mn_3O_4 is explained by the fact that the ignition was performed in a platinum dish, in which case the unburnt gases from the flame permeate the metal and reduce some of the oxide to protoxide, a phenomenon which was observed about the same time by Wright.

The very concordant results which were obtained in this case are given in Table III., and they show that this oxide experienced no alteration whatever in composition on being heated either at 100° or at 180° C., although, considering its poorness in oxygen as compared with No. 1, it might have been expected to have absorbed a large amount of that gas.

TABLE III.

Experiments on the Oxide No. 3.

Before heating—			
41.	37·463	37·467	
42.	37·379		
43.	37·559		
After heating –			
44. At 100° C. ..	37·476	37·514	Not appreciably altered.
45. At 180° C. ..	37·507		
46.	37·559		

(To be continued.)

The Fermentation of Urea.—C. Richet.—Solutions of urea placed in contact with portions of muscular tissue quickly undergo the ammoniacal fermentation.—*Comptes Rendus.*

ON THE HOT SPRING AT NATMOO NEAR MAULMAIN, BRITISH BURMAH.

By R. ROMANIS, D.Sc., Chemical Examiner to Government.

The neighbourhood of Maulmain is remarkable for the number of hot springs. The soil is alluvial with ridges of laterite and carboniferous lime-stone. The nearest of these springs is at Natmoo, in the island of Beloogyoony, which lies between Maulmain and the sea. We found the spring in a thicket of bushes in the middle of rice fields, about two miles from the hills and one from the river bank. It is a circular pool about 12 feet in diameter and 4 feet deep. The edges were incrusted with a white mud which proved to be carbonate of lime. A gas, probably carbonic acid, bubbled up through the water, the temperature of which was 130° F. All around the pool and the stream which flowed from it, lay numbers of a small land shell, a species of Conovulus.

A slab of teak-wood had been erected near. On one side was an inscription in English, stating that the spring had been discovered in 1866, when Col. D. Brown was commissioner of Tenasserim. On the other side was an inscription in Taline saying that the Beloos (ogres) came every night to drink their.

About a quart of the water was brought away and analysed with the following results:—

$NaCl$	10·446		
KCl	0·344		
$CaCl_2$	2·218		
$MgCl_2$	0·855		
SO_3	0·109		
Fe_2O_3	0·002		
$CaCO_3$	0·175		
	14·169	grms.	per litre.
Residue on evaporation	14·07	,,	,,
Chlorine per litre	8·0	,,	,,

A SULPHURETTED HYDROGEN APPARATUS.[*]

By PETER HART.

When hydric sulphide is only occasionally required, and then in small quantities, an apparatus which so furnishes it is useful, especially when it can be used repeatedly without washing out or replenishing. The one I have contrived seems to me to fulfil these conditions. There have been many invented, but they mostly require either many joints or especially formed pieces of glass. This one can be made by any one possessing only very small skill in fitting up apparatus. It consists of two test-tubes, the larger of *one* inch internal diameter, the other of such smaller diameter as to slide easily without friction into the larger. This smaller tube is by means of the blowpipe perforated at the bottom with a quarter-inch hole and is also provided with a rubber stopper and a gas leading tube bent twice at right angles. The larger tube has a piece of rubber tube two inches in length, and of rather smaller diameter than itself, pushed over its mouth, one inch on the tube and one inch projecting. This completes the apparatus. To work it fill the larger tube from one-third to one-half full of a mixture of sulphuric acid and water—one part acid, three parts of water. Drop a lump of iron sulphide into the smaller tube, insert the stopper with leading pipe firmly into this, and thrust its lower perforated end through the rubber mouth of the larger tube, pushing it down until it reaches the acid, and allowing sufficient of this to enter the perforation to cover the sulphide iron. Gas immediately commences to be evolved and can be bubbled through the solution to be examined. When sufficient has been obtained, raise the upper tube until the lower end is out of the acid, the remains of which at once drain away from the sulphide and all action ceases, or practically so. It is only necesaary to hang up the apparatus until again needed, when, by heating the end of the lower tube containing the acid over a Bunsen burner, and pushing down the upper, it commences full action again. This can be repeated until the acid becomes saturated, or so much so as to require replenishing.

Of course it need not be limited to the dimensions I have named. A much larger upper tube might be employed, which, combined with a suitably sized lower bottle would furnish gas enough for a quantitative analysis. By occasionally sinking the upper tube deeper into the acid the stream may be fairly regulated, sufficiently so at all events for ordinary work.

ON THE CONNECTION OF THE MOLECULAR PROPERTIES OF INORGANIC COMPOUNDS WITH THEIR ACTION UPON THE LIVING ANIMAL ORGANISM.

By JAMES BLAKE, M.D., F.R.C.S.

During my prolonged researches on the phenomena elicited by the direct introduction of inorganic matter into the circulation of living animals, I have arrived at results which, as I believe, open a new path to the solution of certain riddles of molecular chemistry. The researches were begun with the intention of applying these simpler and better known substances for the analysis of physiological facts, but in the course of my experiments it became clear that living matter might serve as a means for giving a clue to the molecular properties of inorganic matter. In a discourse delivered in 1839 before the Academy of Sciences of Paris, I showed that when solutions of different salts are introduced into the blood of living animals the physiological action depends on the electro-positive component of the salt, and little upon the acid with which it is combined. A communication which I read at a meeting of the Royal Society in June, 1841, proved that the action of inorganic bodies introduced directly into the blood of living animals depends on their isomorphous relations; and in a memoir communicated to the California Academy of Sciences in 1873, I showed that among the compounds of the metallic bodies, strictly speaking, the physiological efficacy of substances belonging to one and the same isomorphous group was proportionate to their atomic weight; the greater the atomic weight the more intense the physiological action. This is not the place to enter closely into the physiological action of the bodies employed in these experiments. They included salts in 41 elements, and their action was tested upon horses, dogs, cats, rabbits, geese, and hens with identical results. Aqueous solutions of the different salts were injected into the blood-vessels of the living animals. Among those of the monatomic metals were salts of lithium, sodium, rubidium, thallium, calcium, and silver. They all agree exactly in their physiological action. The fatal quantity of lithium sulphate for a rabbit is 1 grm. per kilo. of the animal's weight; whilst of silver nitrate, 0·06 grm. was fatal. Among the diatomic metals tried were salts of magnesium, iron, manganese, cobalt, nickel, copper, zinc, and cadmium, as also calcium, strontium, and barium. In the salts of the magnesium series, the analogy of physiological action is very manifest, and their activity is enhanced with the increase of the atomic weight, rising from 0·97 grm. per kilo. for magnesium sulphate to 0·08 grm. for cadmium sulphate. The salts of calcium, strontium, and barium form likewise a group in which the increasing physiological action is very distinct. being 0·47 per kilo. in calcium chloride and 0·043 grm. per kilo. for

---

[*] A Paper read before the Manchester Literary and Philosophical Society, March 8, 1881.

barium chloride. The physiological reactions of the lead salts resemble those of the barium group, though agreeing in certain reactions with the salts of silver. (Similar transition-reactions were observed in the salts of magnesium, calcium, silver, and gold.)

Among the tetratomic metals, the salts of thorium, palladium, platinum, osmium, and gold were examined. All showed great similarity in their physiological action, ranging from 0·029 grm. per kilo. in thorium sulphate to 0·003 grm. per kilo. in gold chloride. The decided and characteristic effect of this class of substances upon the action of the heart was shown in the most surprising manner by the compounds of gold, which even in the minute dose of 0·003 grm. per kilo. kept up the action of the heart for several hours after death, though the temperature of the body had sunk 13° below the normal heat of the animal.

Among the hexatomic metals, the salts of glucinum, aluminium, and iron (ferricum) agree perfectly in their physiological reactions. The fatal dose per kilo. ranges from 0·023 in glucinum, 0·007 for aluminium, and 0·004 grm. in ferricum, all in the state of sulphates. The physiological action of glucinum confirms the view that glucinum is a hexatomic metal.

Among the rarer earths, experiments were tried with ytterbium, cerium, didymium, lanthanum, and erbium. There was found a marked difference between the cerous and ceric salts as in those of iron. The difference is, however, less, being 1 : 3 in cerium and 1 : 28 in iron. Among the non-metallic elements, compounds of chlorine, bromine, iodine, phosphorus, arsenic, antimony, sulphur, and selenium were examined. Chlorine, bromine, and iodine agree closely in their physiological reaction, but instead of an increase there is here a decrease in intensity. Phosphorus, arsenic, and antimony do not induce any immediately perceptible physiological reaction. Arsenious acid, injected in the proportion of 0·560 grm. per kilo., checks the pulmonary circulation. Sulphur and selenium are similar in their action, the latter being the more powerful. The only exceptions to the rule, that isomorphous substances act in an analogous manner, are the salts of potassium and ammonium. The latter produce results resembling those of certain nitrogenous alkaloids. If the carbon compounds exhibit similar phenomena in their manner of action upon the living animal body, researches concerning molecular relations will be greatly facilitated. Dujardin has already demonstrated in this direction, that in alcohols of one and the same series the intensity of the physiological action is directly as the atomic weight.—*Berichte der Deutschen, Chem. Gesellschaft.*

ON THE

STRENGTH OF SOLUTIONS OF SULPHUR IN CARBON DISULPHIDE, AND ON ITS APPLICATION TO THE ANALYSIS OF SULPHUR ORES.

By H. MACAGNO.

THE specific gravities of several solutions of sulphur in carbon disulphide, obtained at 15° C. with as much accuracy as possible by the method of the specific gravity bottle, give me the means of drawing on a paper ruled into squares the line representing the solubility of sulphur. This line remains perfectly straight from 1·271 to 1·354 sp. gr. at 15°; from 1·354 to 1·390 it becomes scarcely curved towards the edge on which the weights of sulphur are marked. The same happens at various temperatures from 15° to 25°. The curves result symmetrically arranged, and their curvature becomes more and more remarkable with the growth of temperature. For, I think, one must never exceed 25° if accuracy in results is requisite.

By the method of graphical interpolation, the following table has been calculated. It shows the quantity of sulphur in 100 parts by weight of carbon disulphide:—

15° C. Sp. gr.	100 parts of Carbon Disulph. Dissolve—	15° C. Sp. gr.	100 parts of Carbon Disulph. Dissolve—
1·271	0	1·332	14·7
2	0·2	3	15·0
3	0·4	4	15·2
4	0·6	5	15·4
5	0·9	6	15·6
6	1·2	7	15·9
7	1·4	8	16·1
8	1·6	9	16·4
9	1·9	1·340	16·6
1·280	2·1	1	16·9
1	2·4	2	17·1
2	2·6	3	17·4
3	2 9	4	17·6
4	3·1	5	17·9
5	3·4	6	18·1
6	3·6	7	18·4
7	3·9	8	18·6
8	4·1	9	18·9
9	4·4	1·350	19·0
1·290	4·6	1	19·3
1	4·8	2	19·6
2	5·0	3	19·9
3	5·3	4	20·1
4	5·6	5	20·4
5	5·8	6	20·6
6	6·0	7	21·0
7	6·3	8	21·2
8	6·5	9	21·5
9	6·7	1·360	21·8
1·300	7·0	1	22·1
1	7·2	2	22·3
2	7·5	3	22·7
3	7·8	4	23·0
4	8·0	5	23·2
5	8·2	6	23·6
6	8·5	7	24·0
7	8·7	8	24·3
8	8·9	9	24·8
9	9·2	1·370	25·1
1·310	9·4	1	25·6
1	9·7	2	26·0
2	9·9	3	26 5
3	10·2	4	26·9
4	10·4	5	27·4
5	10·6	6	28·1
6	10·9	7	28·5
7	11·1	8	29·0
8	11·3	9	29·7
9	11·6	1·380	30·2
1·320	11·8	1	30·8
1	12·1	2	31·4
2	12·3	3	31·9
3	12·6	4	32·6
4	12·8	5	33·2
5	13·1	6	33·8
6	13·3	7	34·5
7	13·5	8	35·2
8	13·8	9	36·1
9	14·0	1·390	36·7
1·330	14·2	1	37·2
1	14·5		(saturated).

So far as I can discover, no process has yet been proposed for quantitative analysis of sulphur ores, in order to rapidly estimate sulphur with so much accuracy as in industrial purposes can be necessary. The method consisting in burning the ore, and commonly used, gives no reliable results, because organic matters easily decompose the calcium sulphate always present, the water of this salt is lost, and calcium sulphide is produced.

The table, as above, supplies a good and rapid process to within a per cent at least of sulphur in ores.

We must know :—

P = the weight of carbon disulphide taken.
M = the weight of ore mixed with it.
A = the figure resulting from the table, in order to see specific gravity of the solution of sulphur in carbon disulphide at 15° temp.

Then, the per cent x of sulphur in ore will be known by :—

$$x = \frac{AP}{M}$$

In the case of temperatures between 15° to 25°, as it generally may occur, the sp. gr. observed may be reduced to its amount at 15° by means of the following formula, provided it be less than 1·352 :—

$$S = s + 0{\cdot}0014\,(t - 15^\circ),$$

where S = sp. gr. at 15° (that must be $< 1{\cdot}352$).
s = sp. gr. observed, at t of temperature.

Agricultural Station of Palermo, Italy,
March, 1881.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday April 21st, 1881.

Dr. Debus in the Chair.

The following certificates were read for the first time :—A. B. Avarne, A. W. Duncan, T. King Rogers, J. Schwartz, P. Trigger, G. Tate. It was announced that a ballot for the election of Fellows would take place at the next meeting (May 5).

The following papers were read :—

"*On the Distillation of Mixtures of Carbon Disulphide and Carbon Tetrachloride*," by F. D. Brown. These experiments were carried out with the same method as that employed by the author in some similar experiments made about 18 months ago, with carbon disulphide and benzene. An improvement has been made in the still, which, in the present research was of copper, shaped like an ordinary tin can; the upper portion is covered with a copper jacket closed at the top; it has a sloping bottom, at the lowest portion of which is inserted a tube leading to the condenser. The vapour which rises from the boiling liquid is thus not subjected to the cooling action of the air in the neck of a flask, but after rising from the inner vessel descends through the copper jacket and thence through the tube to the condenser. Any liquid which may condense therefore runs into the condenser and not back to the still. The liquids were purified with the utmost care. The composition of the distillates was found, by a careful determination of specific gravities. The objects of the research were:—(1.) To find the boiling-point of every possible mixture of the two liquids, and (2.) the composition of the vapour evolved by any mixture when boiling. Tables and curves accompany the paper. The first set of experiments was made at the ordinary atmospheric pressure. Another set was carried out at a pressure of 434·8 m.m. The author was rather astonished to find that the curves at the two pressures coincided, and that, therefore, "when a mixture of two liquids is boiled, the composition of the vapour evolved is independent of the pressure under which ebullition takes place. This important conclusion the author hopes to confirm by experiments with other liquids. In conclusion, the author discusses the various theories of fractional distillation proposed by Wanklyn, Berthelot, and T. E. Thorpe: he shews that none of the formulæ proposed by these investigators agrees with the results contained in the present paper, and it appears that the general expression for the ratio of the weights x^1, x^2, of the two vapours given off is

$$\frac{x^1}{x^2} = \frac{W_1}{W_2}C$$

where W_1 and W_2 are the relative weights in the mixture and C is a constant (3·5) which replaces the varying ratio of the vapour tensions. The author suggests that the ordinary vapour tensions, which hold good when a vapour is diffused in a vacuum do not hold good when that vapour is diffused in a space containing another gas. He promises further research on this point. He shews that the results obtained by Thorpe, Berthelot, &c., agree with those obtained in the distillation of two substances which do not mix, and suggests that this non-mixing might be determined by the presence of traces of water.

Prof. Hartley then read a paper, "*On the Estimation of Hydric Peroxide by means of Potassic Permanganate*," by W. E. Adeney. The author undertook this investigation in consequence of some statements published by C. T. Kingzett (as to the error which might be caused by using an acid solution of permanganate), which threw some doubt on some results obtained by Prof. Hartley by the above method. As a result of the investigation, it appears that although the numbers previously obtained by Prof. Hartley have to be modified, the conclusions which he drew from these numbers are not affected.

"*On the Oxidation of Sulphurous Acid*," by H. B. Dixon. When sulphur dioxide mixed with a large excess of air is passed over a moist surface, especially if an alkali be present, much sulphate is produced. There is no doubt, moreover, that dry SO_2 and dry O at ordinary temperatures, have no action on each other, but the question still remains open as to whether sulphur dioxide, oxygen, and steam, at 100°, combine to form hydrogen sulphate. This question, which is of interest in relation to the formation or non-formation of sulphuric acid in the combustion of ordinary coal-gas, the author has endeavoured to answer in the present paper. He has observed very carefully whether any diminution of volume takes place when SO_2, O, and steam at 100° are left in contact in McLeod's gas analysis apparatus. No contraction was observed as long as the temperature remained at 100°. On cooling the mixture so as to allow water to condense, a distinct contraction took place; thus a mixture of 38·98 c.c., after standing for two hours at 5°, measured 38·91, and after standing for two hours at 0°, measured 38·86 c.c. The author concludes that sulphurous acid is unoxidised in a damp atmosphere as long as the temperature is above the dew-point, and that the sulphuric acid in a gas-lighted room is formed by the oxidation of hydrogen sulphite, which is first produced by the solution of sulphurous acid in water condensed on cold and hygrocopic surfaces.

Dr. Armstrong thought that the experiments shewed that H_2SO_3 could not exist in a gaseous state, as it was already known that SO_2 could not be oxidised by O under these conditions.

Mr. Kingzett asked if the conditions of the above experiments fully reproduced the conditions existing in a gas jet; there was an enormous difference in the temperatures employed in the two cases, and probably at the high temperature of a gas jet, H_2SO_4 might be formed.

Mr. Page said that temperature had a great deal to do with the oxidation, and instanced the old Letheby sulphur apparatus, in which the quantity of sulphate produced was very much increased when the cylinder was kept hot by some non-conducting covering.

Mr. Dixon said that no H_2SO_4 was produced in an ordinary gas flame, but if the products of combustion were rapidly sucked into cold water, all the sulphur was obtained as H_2SO_3.

"*On the Reduction of Cinnamic Alcohol*," by F. Hatton and W. R. Hodgkinson. When cinnamic alcohol is acted on by sodium amalgam in the presence of a large quantity of water, almost the sole product is β-phenyl-propylic alcohol. If, however, an amalgam containing about 15 per cent of sodium be employed, with but a small quantity of water the reaction proceeds much further. Cinnamic alcohol from storax, boiling between 248° and 252° was digested in a steam-bath with sodium amalgam for 3 or 4 days. Water was then added and the whole distilled in steam. A quantity of an oily body distilled over, which, on distillation, boiled 140° to 147°, and by its odor and analysis was identified as cinnamene. The aqueous portion of the distillate was neutral, but rapidly decolourised a solution of potassic permanganate. It was treated with permanganate until a pink colour remained. On evaporation a potassic salt was obtained, which was converted into a lead salt and analysed; it proved to be a formate. The ultimate reaction is, therefore,—

$C_6H_5.CH : CH.CH_2OH + H_2 = C_6H_5.CH.CH_2 + CH_3OH$; neither α- nor β-phenyl-propylene appear to be formed when the cinnamic alcohol is nearly anhydrous.

The Society then adjourned to May 5, when a ballot for the election of Fellows will be held and the following papers read:—"On the Action of Humic Acid on Atmospheric Nitrogen," by E. W. Prevost; "On the Active and Inactive Amylamines," by R. T. Plimpton; "On the Products of the Action of Alkalies on Ethyl-β-ethyl-acetosuccinate," by T. D. Thorne; "On the Action of Sodium Alcoholates on Fumaric Ether," by T. Purdie.

NOTICES OF BOOKS.

Some Recent Methods of Testing Portland Cement. By Alderman W. H. Bailey (Salford). Manchester: Herald and Waker.

To deal with this pamphlet is no easy task. The "testing" of Portland cement does not refer to its chemical composition, but to its mechanical properties. In consequence, we can scarcely be expected to pronounce with confidence or authority as to the value of the methods discussed. The author remarks that the most popular method of testing Portland cement is by a severe tensile strain, but that "much can be said in favour of testing by compression," and for this purpose he has designed a hydraulic compressor, which was exhibited at a meeting of the Manchester Association of Employers, Foremen, and Draughtsmen, before whom Mr. Alderman Bailey's paper was read, and which is figured and described here. He also gives an account of Prof. Thurston's machine for testing cement by torsion, and of a method of testing, based on tensile strain, and introduced by Mr. Jacob, the Borough-Engineer of Salford. Concerning the comparative merits of these procedures we are unable to decide.

CORRESPONDENCE.

ESTIMATION OF FAT IN MILK.

To the Editor of the Chemical News.

Sir,—I read in the Chemical News, vol. xliii., p. 170, the paper by Mr. Hamlet on the above process. His method seems to me to be, while very ingenious, unnecessarily tedious.

The plan which I have adopted for some years and which gives most accurate results is the following:—I use conical flat-bottom flasks, about three or four inches in diameter. I weigh out about 10 grms. of milk into them, which forms a thin film over the bottom; the flasks are put into the water oven, and in about two hours the milk is dry. Ether is then poured on, the flask corked, and allowed to stand all night. In the morning the flask is connected with a Liebig's condenser, the ether boiled by means of hot water; when the flask is cool the ether containing the fat is poured off into a similar flat-bottom flask. This is repeated about four times, ether being condensed at each operation. The fat is obtained in one flask, and the solids not fat in the other. This method I consider preferable to passing the ether through a tube containing the solid matter, for I have found from experience that the fat is not all extracted by merely passing the ether over the solid matter; that is my reason for leaving the ether on all night.—I am, &c.,

J. Carter Bell.

THE SOCIETY OF CHEMICAL INDUSTRY.

To the Editor of the Chemical News.

Sir,—In the Chemical News, vol. xliii., p. 185, "F.C.S., F.I.C.," wishes to know how far the sub-division of Chemical Society is to be carried, and proposes an alternative to the course adopted by the promoters of the new Society. May I, as an interested person, be permitted to ask why he did not, during the twelve months or more that this project has been under consideration, at the meetings, or by letter, as invited by the committee appointed to discuss such matters, give us the benefit of his ideas, which might then have been of some practical use, instead of keeping them all to himself and coming forward now with a heap of afterthought, to throw as a damper upon the final decision of the committee, and upon the prospects of what appears to be, so far, a very promising undertaking.

As regards the two institutions of which your correspondent is a member, the Chemical Society has nothing in common with the proposed new association, though it might certainly have accomplished the desired object by the formation of a technical section as suggested by your correspondent, and this might possibly have been more advantageous to chemists generally than the establishment of a separate technical institution.

The Institute of Chemistry was formed some three years ago for some purpose or other, partly, I believe, to give us by examination or otherwise, something analogous to the qualification conferred by the Pharmaceutical Society upon its members, but it appears to me that the rules for the admission of members, &c., are such as will eventually strangle the Society, by preventing the admission of the very class which ought to be the backbone of such an association, namely, the technical chemists themselves.—I am, &c.,

Caustic Alkali.

SPONTANEOUS IGNITION OF HYDROCARBON VAPOURS.

To the Editor of the Chemical News.

Sir,—As your space has lately been occupied by much that is of great interest to tar distillers, perhaps you will kindly find room for a subject equally interesting to some of them. Some short time since, I had the misfortune to have my pitch cooling chamber destroyed by an explosion; which, as there was no evidence to show that it had been occasioned directly or indirectly by the ordinary means of ignition, has led me to believe that it is possible under certain circumstances—it may be of temperature or the various proportions of atmospheric air which may get mixed with the hot hydrocarbon gases—for the mixture of vapour to ignite spontaneously.

If this theory is correct, and I am led to understand that many tar distillers hold this view, I shall be glad to have any information that may tend to explain the cause of such explosions (which fortunately are not so alarmingly frequent, though serious enough when they occur), as, perhaps, with a knowledge of the laws of their cause, they might in many cases be prevented.—I am, &c.,

Hydrocarbon.

AN AVOWAL.

To the Editor of the Chemical News.

As one who at the first meeting of the Society of Chemical Industry cast some ridicule on the newly introduced profession of "Chemical Engineer" ("Ch.E." ?), permit me now to frankly confess that I believe I was mistaken.

Though I took honours at college in chemistry and physics, and am a successful inventor of chemical plant and processes, nevertheless, because I am not a chemical manufacturer "on my own hook," I found myself, with the census form before me, an animal of a nondescript genus. Thanks, however, to those who were the first to practically realise the dignity and national importance of their calling, there was a way out of the quandary. With a good conscience I described myself as a

Chemical Engineer.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, l'Académie des Sciences. No. 12, March 21, 1881.

The Possibility of Rendering Sheep Proof against Splenic Fever by the Method of Preventive Inoculation.—M. Pasteur.—The author, whilst agreeing with M. Toussaint as to the successibility of this treatment, criticises certain opinions advanced by the latter.

Researches on the Formic Ethers.—MM. Berthelot and Ogier.—The formic ethers, like acetic ether and the oxalic ethers, are formed with absorption of heat from the alcohol and the acid.

Distribution of Energy in the Normal Solar Spectrum.—S. P. Langley.—The total quantity of heat poured by the sun upon the earth is much greater than has been supposed. Previous to the atmospheric absorption this maximum must lie much nearer the violet than the extreme red. The totality of the solar radiations, if it could reach us, would give a sensation of blueness rather than of whiteness. The atmosphere which we regard as transparent plays the part of a strongly coloured medium.

Synthetic Apparatus Reproducing the Phenomenon of Double Circular Refraction.—M. Gouy.—Not capable of useful abstraction.

The Radiophony Produced by the Aid of Selenium. E. Mercadier.—The sounds produced in the selenium receivers which the author has studied result chiefly from the action of the luminous vibrations. The rays of the spectrum act from the limit of the blue towards the indigo as far as the extreme red, and even a little below the red. The indigo, violet, and ultra-violet rays are without perceptible effect. The maximum action is always in the yellow portion of the spectrum. Glass tube receivers containing air in contact with a smoked surface gave a very different result. The active rays extended from the orange beyond the red to a limit which may be at the third or fourth the length of the visible spectrum, the maximum effect being in the lower red. The other radiations of the spectrum from the yellow to the ultra-violet do not produce any sensible effect. The action is chiefly thermic.

Experiments made at the Creusot Works for the Optical Measurement of High Temperatures.—A. Crova.—The author found that the most convenient method consisted in projecting by means of a lens the image of a circular aperture, made in the outer door of a Martin-Siemens furnace, upon the reflector prism of the spectro-pyrometer. It was easy to observe, even in full daylight, the two spectral bands of the red and green regions taken as fixed points of the optical scale. When the furnace was in a state of normal activity the optical degree obtained corresponded to a temperature of about 2000°. The temperature of melted steel was about this point, and that of cast-iron when running into the orifice of the Bessemer converters varied from 1110° to 1150°. The flame of the Bessemer converters did not admit of measurement on account of the green bands which appeared in its spectrum. The measurement of temperatures below 1000° presents difficulties which may be overcome by a modification of the instrument.

Electro-motor Forces of the Galvanic Arc.—F. P. Le Roux.—Not susceptible of useful abstraction.

Hissing of the Galvanic Arc.—A. Niaudet.—The arc sometimes gives rise to a hissing, which under certain circumstances may become an intense noise. The author finds from his experiments that the difference of potential between the two carbons has two very different stages, the greater when the arc is silent and the smaller when it hisses. The needle of the galvanometer springs abruptly from one region to another when silence begins or ceases. The smallest, the most momentary noises, are reproduced by a movement of the needle. When silence is well established the needle may remain steady for a long time.

Magic Mirrors of Silvered Glass.—L. Laurent.—The so-called magic effect may be produced by the manner of fixing the mirror in its frame.

Efflux of Gases.—M. Neyreneuf.—The verification of the laws of efflux of gases may be effected by a process which recalls the methods in use for the determination of electric resistances.

New Compounds of Hydrobromic and Hydriodic Acid with Ammonia.—L. Troost.—The first of these compounds consists of 1 equiv. hydrobromic acid and 2 equivs. ammonia. It is anhydrous and has no analogue among the compounds of hydrochloric acid with ammonia. A second compound is a tetra-ammoniacal hydrobromate. It is anhydrous and melts at +6°. A third compound is the hepta-ammoniacal salt which melts at −20°. Hydriodic acid forms analogous compounds.

Action of Hydrochloric Acid upon Lead Chloride.—A. Ditte.—In the author's memoir on the action of hydrochloric acid upon the metallic chlorides he has omitted lead chloride, which behaves in a special manner. The solubility of this salt in water decreases at first as increasing proportions of acid are added, but with a further increase the solubility of the salt becomes greater. Lead bromide and iodide behave in a similar manner in presence of their respective hydracids.

Behaviour of Sulphuric Acid recently Heated to 320° with Oils.—E. J. Maumené.—Acid recently heated, without having lost the least trace of water, presents very different reactions from those of the same acid which has been prepared for some time, at least as far as the liberation of heat is concerned. Upon this reaction the author has based a method for the analysis of oils, which has been confirmed by Fehling. It being required to show the difference among numerous specimens of linseed oil, according to their source, age, &c., two series of assays were made, the one with ordinary acid at 83·5° (densimetric), the other with the same acid heated to 320°, cooled, and used after it had assumed its ordinary temperature. In these two series the quantities of heat liberated were respectively very different, the acid recently heated developing very much higher temperatures. The results furnished by this process are constant with one and the same acid, and may be obtained with 25 c.c. of oil and 5 of acid.

A New Method for the Analysis of Oils.—E. J. Maumené.—The author treats a measured quantity of oil with a measured quantity of standard caustic alkali. Ten c.c. of oil measured with a pipette were heated in a boiling water-bath for an hour with 20 c.c. of a solution of potassa, which would neutralise 123 c.c. of sulphuric acid at 98 grms. = 1000 c.c. At the end of this heating the linseed oils mentioned in the previous memoir all yielded a cake of soap, solid or very firm when hot, always solid when cold, and easily separated by mere draining. The alkaline solution is very differently acted upon by different samples. It still neutralises smaller quantities of acid, differing in case of every sample.

Separation of Nickel Oxide and Cobalt Oxide.—G. Delvaux.—The author proposes to give a process for the separation of the two metals, derived from two known methods, and permitting the exact determination of the two oxides, and the preparation of the two metals in a state of purity. The two fundamental processes are that of Pisani, who uses caustic potassa in presence of an ammoniacal liquid, in which are dissolved the two metals, with exclusion of air. The nickel oxide is precipitated alone in bulk, but always carries down with it more or less of cobalt oxide. The second method is that of Terreil, who precipitates cobalt in an acid solution in the state of roseo-cobaltic hydrochlorate. The cobalt oxide is peroxidised by means of permanganate. We suppose that the two bodies, cobalt and nickel, have been obtained by known methods, either as pure oxides or pure sulphides, free from all foreign matter. The mixed oxides or sulphides are dissolved in an *aqua regia* containing a large proportion of hydrochloric acid. The solution is largely diluted with water and saturated with ammonia in excess. Permanganate is then added until the solution remains rose coloured for some time. Pure potassa is then added, when the nickel is precipitated as hydroxide, carrying with it manganese oxide, derived from the permanganate. The precipitate is washed by decantation and filtered; redissolved in hydrochloric acid, and treated again with ammonia, permanganate, and caustic potassa. The washing-waters which contain the cobalt are collected, saturated with acetic acid, and precipitated by sulphuretted hydrogen. The mixture of nickel and manganese oxides is re-dissolved in hydrochloric acid, and the solution saturated with ammonia. The solution is exposed to the air for some time, and the manganese oxide is by degrees entirely precipitated. It is filtered off, the filtrate is saturated with acetic acid, and the nickel thrown down by means of sulphuretted hydrogen. The process may be employed on the large scale for obtaining nickel completely free from cobalt.

A Process for the Industrial Preparation of Potassium Carbonate.—R. Engel.—Potassium chloride may be directly converted into carbonate in the following manner:—Magnesium oxide or carbonate is added to the aqueous solution of potassium chloride, and the mixture is added in presence of carbonic acid. There is formed magnesium bicarbonate, which dissolves, reacts upon the potassium salt, and precipitates it as a double carbonate of the two bases. This precipitate is crystalline and may be easily separated from the mother-liquors. If it is heated, either dry or in presence of water, carbonic acid escapes, and the double salt is resolved into potassium carbonate and magnesium carbonate, which are separated by water. The carbonate of magnesia serves for a fresh operation.

Certain Complex Compounds of Sulphur and Nitrogen.—Eug. Demarçay.—The compounds in question are dithio-tetra-thiazyle bichloride and thio-dithiazyle bichloride. For their preparation and properties we must refer to the original memoir.

The Tar of Cork.—L. Bordet.—Cork-waste has been for some time used for the manufacture of lighting gas. The products are at once analogous to those yielded by wood and by coal. The author has obtained acetic acid and methylic alcohol ammonia and hydrocarbons similar to those of coal. The ketons characteristic of wood-tar are wanting.

Journal für Praktische Chemie.

Parts 5 and 6, 1880.

Analysis of the Kaniz or Kainzen Spring.—F. Hulwa.—This spring is distinguished by the absence of free carbonic acid and the abundant occurrence of sodium carbonate.

How to Write a Chemical Manual.—H. Kolbe.—A somewhat caustic notice of the "Chemistry of Carbon Compounds," by Dr. V. von Richter.

A Curiosity.—It is announced that Otto Fischer will give lectures at the University of Munich on "Aromatic Chemistry." The editor asks if a course on "Fatty Chemistry" is to follow?

Parts 7 and 8, 1880.

Volume-Chemical Studies.—III. On the Mass-Action of Water.—Dr. W. Ostwald.—As early as 1847 H. Rose pointed out the important part played in chemical reactions by the "mass action" of water, and he showed by a series of examples that this liquid, formerly considered as indifferent, can develop very noteworthy affinities. The following researches refer to the reciprocal action between sodium sulphate, sulphuric acid, and water. Four solutions of sodium sulphate were prepared, in each of which 1 atom (= 142 grms.) was dissolved respectively in 1, 2, 3, and 4 kilos. of water. Four corresponding solutions of sulphuric acid were prepared, and each sulphate solution was mixed with each sulphuric acid solution in five proportions, 1 vol. sodium sulphate being respectively mixed with $\frac{1}{3}$, $\frac{1}{2}$, 1, 2, and 3 vols. of the sulphuric acid. Among other results it appears that in presence of large quantities of water with an excess of sodium sulphate a greater quantity of the acid salt remains undecomposed than with an equivalent excess of sulphuric acid; the latter is more interfered with in its action than the former by its affinity for water.

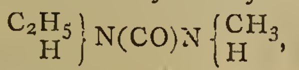
Arsenic Sulphide as a Poison, and its Import in Judicial Investigations.—J. Ossikovsky.—The question was raised whether in a certain dish of cabbage containing arsenic sulphide, there was poison enough to prove fatal to a man. From a number of experiments the author concludes that arsenic sulphide, whether prepared in the moist way, or the orpiment of commerce used by painters, forms, in contact with putrescent organic matter, arsenious and small quantities of arsenic acid. In cases of poisoning with arsenic sulphide these oxidation-products appear sooner or later according to circumstances. Hence, if articles of food, vomited matter, &c., are only sent for chemical examination after the interval of weeks, or perhaps months, the expert cannot give a definite answer to the question whether the poison was sufficient in quantity to prove fatal to a man.

Process of Decomposition in a Putrefying Hen's Egg.—Dr. C. O. Cech.—It appears that in the north of Russia some wholesale dealers have each season to dispose of more than 500,000 bad eggs. The author finds that such eggs may be classed in seven groups, according to the stage of decomposition. He proposes to extract the so-called egg-oil, which may be used in the manufacture of soaps. He afterwards suggests that putrid eggs may be applied in the manufacture of artificial manure.

The Disinfective Action of the Chlorphenols.—Dr. C. O. Cech.—Trichlorphenol appears to have the greatest disinfective power. The corrosive and poisonous properties of phenol decrease with an increasing proportion of chlorine.

Occurrence of Nitrates in Certain Vegetable Raw Materials and their Determination.—Isidor Bing.—The author has detected and determined nitrates in four kinds of tea, in maté, coffee, and valonia. The author used Tiemann's method as modified by Schulze (see *Berichte Deutsch. Chem. Gesell.*, 1873, p. 1038).

Two Remarkable Cases of Metamerism in Organic Compounds.—Dr. L. Schreiner.—The author has obtained methyl-carbonic ethyl-ether, $CH_3O(CO)OC_2H_5$, and ethyl-carbonic methyl-ether, $C_2H_5O(CO)OCH_3$. The latter compound has the same odour as the former, but a lower sp. gr., and boils under a pressure of 730·1 m.m. at 115·5°, *i.e.*, more than 10° higher than the former. The author has also obtained ethyl-methyl-urea,—



$$\left.\begin{matrix}C_2H_5\\H\end{matrix}\right\}N(CO)N\left\{\begin{matrix}CH_3\\H\end{matrix}\right.,$$

and methyl-ethyl-urea,—

$$\left.\begin{matrix}CH_3\\H\end{matrix}\right\}N(CO)N\left\{\begin{matrix}C_2H_5\\H\end{matrix}\right.,$$

The former body melts at 105° and congeals again at 101°. The latter melts at 75° and congeals at 72°.

Remarks on the Foregoing Memoir.—G. Hüfner.—Dr. Schreiner not having the opportunity to continue these researches they will be taken up by the writer.

Remarks on the above Paper.—H. Kolbe.—The author criticises the views of Kekulé, of which he enumerates five: The dogma of the constant valence of the elements; the dogma of the equal valence of the four units of affinity of quadrivalent carbon; the dogma of the movement of atoms in the molecule; the dogma of the equal valence of the six hydrogen atoms of benzol, and the dogma, or, more correctly, the invention of the benzol ring. The second of these being dispelled by the researches of Dr. Schreiner, the fourth and fifth fall to the ground, and of the dogmas of the so-called modern chemistry there remains nothing but undeception.

Certain Derivatives of Isophthalic Acid.—Bruno Beyer.—The author has prepared isophthalylamide, and has commenced the study of the nitro-isophthalic acids.

Researches on the Physical Chemistry of the Blood.—G. Hüfner.—A long and illustrated memoir, which does not admit of useful abstraction.

Analysis of the Mineral Spring of Niederbroun in Alsace.—Dr. E. Burt.—The mud deposited by this water contains arsenious acid, lead sulphate, ferric oxide, and traces of antimony, copper, zinc, and manganese.

Oil of Coffee.—C. O. Cech.—The oil in question is green, transparent, and flows slowly. The author's researches are incomplete.

Colouring-Matter of Rubus Chamæmorus.—C. O. Cech.—Cotton, wool, and silk—the last-mentioned fibre least completely—quickly take an intense and permanent orange if boiled with the juice of these berries. The author recommends it as a cheap and useful dye for buff, amber, and orange shades, and for giving white wines a Tokay or Sherry colour. The berry is perfectly harmless.

Chemiker Zeitung.
IV., No. 19.

Retrospect of the Progress of Pure Chemistry in the First Quarter of 1880.—"To Crookes, the celebrated discoverer of thallium and of the radiometer, and editor of the CHEMICAL NEWS, belongs the merit of drawing the attention of the scientific world to those movements of gases which take place in highly exhausted receivers under the influence of electric currents. After having communicated two papers on this subject to the Royal Society of London in 1878 and 1879, there appeared in the CHEMICAL NEWS his treatise 'On Radiant Matter,' which was quickly known and discussed amongst us. Whilst he performed his brilliant experiments in Paris before a select circle of French men of Science, German investigators, and especially Wiedemann and Gintl, considered that his conclusions were incorrect, and that his assumption of radiant matter as a fourth state of aggregation was unfounded. Still, in spite of his treatise containing much that was already known, it is the indisputable merit of this gifted English experimentalist to have brought together all the known facts and explained them by excellent illustrations. The charge that Crookes has too little regarded German researches, especially those of Hittorf and Goldstein, may be justified.* But the treatise contains a great number of original ideas."

Nitric Acid Injector.—Fr. Bode.—This contrivance for introducing nitric acid into the chambers cannot be intelligibly described without the accompanying illustration.

Rapid Detection of the Presence of Water in Alcohol and Ether.—Carl Mann.—If an aqueous solution of 2 parts crystalline tartaric acid is mixed with 1 part of molybdic acid and evaporated to incipient fusion in a porcelain capsule, the deep blue mass which is formed, if heated with 30 to 40 parts of water, yields along with a fixed residue a faint yellowish brown filtrate, holding in solution the citrate of a molybdenum compound, which has the property of appearing deep blue in its anhydrous state, but almost colourless when hydrated. If a slip of filter-paper is steeped in this molybdenic solution (not too dilute) and dried at 100°, the blue colour reappears with great intensity. The paper, if screened from direct sunlight retains its colour. If it is plunged in pure water the blue colour disappears at once; the paper becomes white and the water is not coloured. At 50° the decolouration is instantaneous; at 18° to 20° in two or three seconds, and at 10° in five to eight. With absolute alcohol or ether in a stoppered bottle the blue colour of the paper remains unaffected. This reagent for water is not acted on by aceton, aldehyd, methylic alcohol, and mixtures of amylic and ethylic alcohol. If plunged in spirit of wine the blue colour disappears more rapidly the more water is present.

Researches on the Radiant Matter of Crookes and the Mechanical Theory of Electricity.—Dr. W. F. Gintl, abstracted by Dr. von Gerichten.—The author discusses the question whether, according to the experiments of Crookes, the assumption of an especial fourth state of aggregation is necessary, or whether the facts may be satisfactorily explained without such hypothesis? He shows that the latter alternative is possible with the aid of a mechanical theory of electricity. If the radiant matter produced in the vacuum is a phenomenon *sui generis*, produced by the action of electricity and heat upon the molecules of gas remaining in the receiver, it is in the first place doubtful to apply to it the conception of an aggregate condition. The author considers it impossible to form a clear understanding of the phenomena in accordance with the theory of Crookes, or to find in the facts any evidence of the existence of radiant matter. An explanation of the latter phenomenon is thus given:—Particles become separated from the surface of the substance of the negative pole, they are repelled, and they move away from the pole with a speed resulting from the antagonistic forces in a parallel and rectilinear direction, preserving their speed and their initial path so long as they do not meet with obstacles which influence their movement. At a certain density of the gases present in the exhausted space, these particles, in consequence of the impact of gaseous molecules more or less opposed to their direction of movement, lose their velocity after travelling a short distance and soon come to rest. The more dilute the gas the smaller is the number of the impacts of the gaseous molecules encountering the molecules of the poles, and at a certain degree of dilution the repelled polar particles will be able to traverse the space open to them without any essential alteration in their speed, the small number of the existing gaseous molecules being no longer able to retard the molecules of the polar on their journey through the apparatus. The luminous phenomena of the

---

* The authors of this charge have evidently only seen abstracts of my paper. Had they taken the trouble to refer to the original paper "On the Illumination of Lines of Molecular Pressure and the Trajectory of Molecules," published in the *Phil. Trans. of the Royal Society*, Part I., 1879, being the Bakerian Lecture for the year 1878, they would see that full credit is given to the researches of both Hittorf and Goldstein.—W. C.

Geissler tubes the author supposes to be produced by the intense blows which the gaseous molecules receive from the polar molecules flying rapidly through the apparatus. The intensity of the luminous phenomena will naturally decrease with the number of the photophorous particles occupying the space. Accordingly in the experiments of Crookes, on continued rarification of the gas, a condition was reached where a display of light is no longer perceptible, or can be made visible merely by the aid of fluorescent bodies. A condition may also appear, as is shown by Crookes's experiment, with the metallic plate intercalated as negative pole in the middle of a Geissler tube, with the positive poles at the ends. In this case the gaseous molecules are, so to speak, driven away by the polar particles endowed with an equal initial velocity, till at a certain distance from the pole the mass of the gaseous molecules and their speed become so great that a luminous display begins. In an analogous manner the author explains the phenomena of phosphorescence which Crookes elicits by the action of his radiant matter. In like manner the thermic and the mechanical effects are most simply explained, according to the expression selected by Crookes himself as the results of a "continued molecular bombardment." The attraction of the so-called radiant matter, regarded as a stream of metallic particles, by the magnet will not appear surprising.

Justus Liebig's Annalen der Chemie, Band 205, Heft 2.

Certain Derivatives of Isobutyl-aldehyd.—Andreas Lipp.—The author examines the behaviour of this compound with ammonia, and the reaction of the isobutyl-aldehyd-ammonia compound thus obtained with hydrocyanic acid, obtaining thus amido-isovaleronitril, the corresponding amide; also α-amido-isovalerianic acid, imido-isovaleronitril, hydroxisovaleronitril, hydroxisobutyl-formic amide, with the corresponding acid and its salts.

Action of Sulphuric Acid upon Substituted Nitro- and Amido-Benzols.—Jul. Post.—This very lengthy memoir treats of the sulphuration of para-nitro-phenol, the nitration of ortho-sulpho-phenol, the amidation of the same compounds; the examination of the amido-sulpho-phenols obtained by different methods concerning their identity and isomerism; the transformation of ortho-sulpho-phenol into the para- compound; a description of the ortho-nitro-ortho-amido- and diortho-amido-phenols, and of their nitro-substitution-products; the introduction of bromine and iodine into para-nitro-ortho-sulpho-phenol; the sulphuration of nitramido- and diamido-benzol both in the ortho- and the meta- series, and the formation of amido-sulpho-benzols both from nitro-benzol and from aniline in order to prove the difference of the respective products.

Experiments on the Oxidation of Nitrogenous Methylised Benzol Derivatives.—A. Brückner.—The compounds operated upon are anhydro-benzamido-para-toluilic acid, anhydro-diamido-para-toluil-xylol, and the benz-toluidines.

The Constitution of Benzol.—Julius Thomsen.—The author concludes from his experiments that the six carbon atoms of benzol are linked together by nine simple connections, and the prevalent assumption of a constitution of benzol with three simple and three double connections does not agree with experiment.

Discovery of Methylamines in Commercial Trimethylamine-hydrochlorate.—L. J. Eisenberg.—The double salt prepared from the commercial hydrochlorate is perfectly identical with the trimethylamine-hydrochlorate obtained by Hofmann from the brine of herrings.

Moniteur Scientifique, Quesneville. January, 1881.

Industrial Society of Mulhouse.—Session of Nov. 10, 1880:—

M. Camille Kœchlin recommends the use of naphthol to prevent solutions of albumen from putrefying. It is stirred up in water in the proportion of 250 grms. per litre, and added as may be required.

A letter by M. Gartner was communicated on the use of certain sea-weeds from the Japanese coasts, as substitutes for starch, glue, and albumen.

M. A. Scheurer gave an account of the researches of M. Prud'homme on a new colouring-matter derived from cœruleine.

M. Trampedach, of Mitan, has succeeded in obtaining from blood-serum a colourless albumen, capable of being substituted for egg-albumen in all cases.

M. Witt has resumed the study of the compound $C_{36}H_{29}N_5$, which he obtains by treating diphenyl-nitrosamine with aniline, and also by the action of nitroso-phenol on aniline hydrochlorate. M. Kimich's azophenine is probably the same body. This compound, if heated to 250° with concentrated sulphuric acid, is converted into a new colouring-matter, which is not attacked even by boiling sulphuric acid. On the addition of water it gives a sky-blue solution with a strong red fluorescence, and presenting three broad absorption-bands in the red, the yellow, and the green.

The Analysis of Waters.—A. Wanklyn and Th. Chapman.—A translation of the well-known treatise of these chemists.

Detection of Phosphorus in Urine in Cases of Poisoning.—F. Selmi.—The urine passed on the first day gave the following results: it gave off a volatile product capable of reducing silver nitrate without affecting lead acetate. It contains a small proportion of albumen: it contains one of the mineral acids of phosphorus, or at least a compound which is capable of precipitating baryta in an alcoholic solution, and which in presence of nascent hydrogen gives off hydrogen phosphide. It yields a volatile phosphoric product, ammonia, and two volatile bases (one containing phosphorus): these substances distil over along with alcohol. It yields two other non-phosphoric bases, one fixed and the other volatile, which are extracted by chloroform from the aqueous residue after the distillation of the alcohol. Along with the volatile base is found a small quantity of a product having the odour of conicine. The odour of trimethylamine is also perceptible. In doubtful cases the author considers that an examination of the urine yield valuable data.

Memoirs of the Academy of Sciences of Bologna.

Action of certain Non-organised Ferments at Low Temperatures.—F. Selmi.—Amygdalin is easily split up at 0° into glucose, benzoyl hydride, and hydrocyanic acid. At $-15°$ the decomposition is greatly retarded. Human saliva saturated with common salt rapidly converts starch into glucose at 0°. At $-20°$ the conversion does not set in until after a contact of thirty minutes. An aqueous solution of diastase, saturated with salt, converts starch into glucose at 60° to 65°, after an hour's contact. At lower temperatures the reaction does not set in. The pancreatic juice converts starch into glucose in a mixture of salt and snow.

Revue Universelle des Mines, de la Metallurgie, &c., Tome 8, No. 2, September and October, 1880.

Explosion of the Royal Gunpowder Mills of Wetteren. — Prof. Chandelon. — The catastrophe is ascribed to the conduct of the men in charge of the steam drying apparatus.

Reimann's Färber Zeitung, No. 1, 1881.

A correspondent states that a quantity of copperas was accidentally thrown into the cistern supplying the boilers in a dye-house. So much hydrochloric acid was evolved by double decomposition with the chlorides present in the water that the strangest alterations took place in the shades which were being dyed, especially orchil and safflower colours.

No. 2, 1881.

An outcry has arisen in Halle, about poisonous tarletanes got up with copper arsenite. Dr. Reimann points out in reply that copper arsenite is not a "splendid green colour," and that for such goods as tarletanes, Guignet's green, which contains no arsenic, has superseded the poisonous Schweinfurt green.

D'Andiran and Wegelin, of Mulhouse, supply for aniline blacks, not pure aniline, but a mixture of 2 parts aniline and 1 part xylidine or cumidine.

No. 3, 1881.

Kohlrausch proposes to extract tannin, not by boiling powdered astringents, but by reduction to fragments of the size of a nut and treating them in a series of dialysers, the bottom of which is formed of animal membranes, or of parchment paper, and permits the passage of the solution of tannin.

No. 4, 1881.

Guinon proposes to bleach tussah-silks by steeping in soda-lye at 3° B., and at the heat of 100° (!). It loses its gum and 12 per cent of its weight, and is rendered white without loss of lustre. The treatment must not last longer than a quarter of an hour. The silk is then washed, and passed through dilute sulphuric acid. The fibre is not injured, but the affinity for colours is reduced.

No. 5, 1881.

Prof. Merz and Weith, of Zurich, have discovered a new colouring-matter, which they name "sun-gold." Its composition will not be made known till a patent has been obtained. (But Switzerland has no patent-laws !)

NOTES AND QUERIES.

⁂ Our Notes and Queries column was opened for the purpose of giving and obtaining information likely to be of use to our readers generally. We cannot undertake to let this column be the means of transmitting merely private information, or such trade notices as should legitimately come in the advertising columns.

Waterproofing.—I wish to waterproof one side of common straw-board and mill-board with silicate of soda, and shall feel obliged if one of your readers will inform me of the cheapest plan, and how long it will take to dry hard.—E. J. L.

MEETINGS FOR THE WEEK.

Monday, May 2nd.—Medical, 8.30.
— Society of Arts, 8. "The Art of Lace-Making," Alan S. Cole.
— Royal Institution. Annual Meeting, 2.
Tuesday, 3rd.—Civil Engineers, 8.
— Quekett, 8.
— Royal Institution, 3 p.m. "Non-Metallic Elements," Prof. Dewar.
Wednesday, 4th.—Society of Arts, 8. "Buying and Selling; Its Nature and Its Tools," Professor Bonamy Price, M.A.
Thursday, 5th.—Royal, 4.30.
— Royal Institution, 3. "Magnetism," Professor Tyndall.
— Chemical, 8.30. Ballot for the Election of Fellows. "On the Action of Humic Acid on Atmospheric Nitrogen," E. W. Prevost. "On the Active and Inactive Amylamines," R. T. Plimpton. "On the Products of the Action of Alkalies on Ethyl-β-ethyl-aceto-succinate," L. D. Thorne. "On the Action of Sodium Alcoholates on Fumaric Ether," T. Purdie.
Friday, 6th.—Royal Institution, 8. "The Land Systems of England and of Ireland," Hon. Geo. Brodrick, 9.
— Geologists' Association, 8.
Saturday, 7th.—Royal Institution, 3. "Scotland's Part in English Literature," Prof. Morley.

THE CHEMICAL NEWS
AND
JOURNAL OF PHYSICAL SCIENCE.

Edited by WILLIAM CROOKES, F.R.S.

Published every Friday. Price 4d. Annual Subscription, post free including Indices, £1

CHARGES FOR ADVERTISEMENTS.

	£	s.	d.
Five lines in column (about 10 words to line)	0	3	6
Each additional line	0	0	6
Whole column	1	15	0
Whole page	3	0	0

A reduction made for a series of insertions.

Cheques and Post-Office Orders, crossed "London and County Bank," payable to the order of William Crookes.
BOY COURT LUDGATE HILL LONDON, E.C

IRISH HILL BAUXITE (Alum Clay).

THE **IRISH HILL MINING CO.** are now, and always have been, the LARGEST PRODUCERS OF THIS CLAY, of Superior Quality, and supply the Manufacturers of Alum, Sulphate of Alumina, and Alum-Cake, of the United Kingdom, America, and the Continent, almost exclusively.

ANALYSIS BY JOHN PATTINSON, ESQ.

	Dried at 212° F.		
	Gertrude (extra qual.)	1st Quality.	2nd Quality.
Alumina	59·00	53·83	52·00
Peroxide of Iron	0·47	1·57	4·57
Silica	18·00	8·67	12·00
Titanic Acid		5·80	6·20
Lime, Magnesia, Potash, Soda, and Sulphuric Acid	0·23	0·83	1·14
Combined Water	22·30	29·27	24·00
	100·00	99·97	99·91

Our MINES, DRYING KILNS, and GRINDING MILLS are situated very close to the Shipping Ports of BELFAST and LARNE, and adjacent to Railways running alongside both Steamers and Sailing Vessels at both Ports, from either of which shipping is abundant and cheap, therefore we can guarantee Regular Delivery as Buyers require it, and are prepared to quote prices f.o.b. c.i.f., or delivered at any Port, in Bulk or Bags, Lump or Ground.

GEO. G. BLACKWELL, *Managing Director.*

Richmond Buildings, 26, Chapel St.,
Liverpool.

ESTABLISHED 1798.

ROBERT DAGLISH & CO.,

ENGINEERS, BOILER AND BRIDGE MAKERS, MILLWRIGHTS,

BRASS AND IRON FOUNDERS.

Manufacturers of every description of Condensing, or High-pressure Blowing, Pumping, Rolling, Winding, and Patent Steam-engines, of any required power, for Irrigating, Draining, Mining, Rolling Mills, or Water Works purposes, and Manufacturers of every description of Chemical, Colliery, Copper Ore, Gold Mining, Glass, and Rock-salt Machinery.

Black-ash Revolving Furnaces of the Most Approved Type.

Bessemer Steel-Rail Plant.

Compressing-Engines for Collieries, Iron Works, and Weldon's Patent Bleaching-Powder Process.

Caustic, Chlorate, Decomposing, Nitre Nitro-Glycerine, Iodine Potash, Sulphur, Acid, and Oxalic Pans.

Gas Producers Patent for Heating and other Purposes.

Pyrites Burners for Irish, Norwegian, and Spanish Ores of Improved Construction.

Patent Rousing Machinery for Brewers.

Retorts, Acid, Gas, Iodine, Nitric, Nitre Nitro-Glycerine and Vitriol Refining.

Steam Superheaters improved for Oil, Tar, and Resin Refining.

Steam Sulphur Melter.

Stills for Oil, Resin, and Tar.

Wheels, Bevel, Mitre, and Spur Moulded on the Shortest Notice by Patent Machinery.

Makers of Mactear's Patent Carbonating Furnace, Jones and Walsh's Patent Sulphate of Soda Furnace, Parnell and Simpson's Patent Causticiser, and Kynaston's Patent Alum Plan

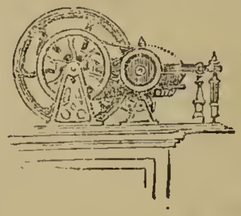
Lists sent on Application.

Photographs, Plans, and other information supplied on receipt of Order.

ST. HELEN'S ENGINE, BOILER, AND BRIDGE WORKS
AND FOUNDRY,
LANCASHIRE.

Carr's Patent Paint and Drug Mill.

Approved by some of the most eminent Chemists, and awarded the Silver Prize Medals of the Manchester and Liverpool, and the Middleton Agricultural Shows.



From Messrs. E. H. SMYTH & Co., 21 Duke Street, Edinburgh, and 69, Coleman Street, City, London.—The small Levigator Mill we recently got from you works most efficiently, and is a great economiser of time.

The chief feature in this machine is, that although it can be turned with ease by a boy, it has immense frictional power for levigating purposes. This is caused by the runner being driven at a much greater speed, but in the same direction, than the bowl. The surfaces being Minton ware, they are clean, smooth, and durable.

Testimonials on application.

£11 nett cash, delivered in Manchester.

The diameter of the bowl is 18 ins., and it and the runners are made of Minton ware. It is useful for Painters, Chemists, Grocers, and Cooks, for triturating and mixing Medicines, Vegetable Powders, Ointments, Paints, Sugar, Salt, Spices, Herbs, Meat for Potting, and will grind the COARSEST EMERY INTO A NEARLY IMPALPABLE POWDER in a few seconds. The pan can be tilted for emptying, as shown in the dotted lines; it can be worked by hand or power.

SOLE MAKERS—

W. H. BAILEY & Co., Albion Works, Salford, Manchester

BERNERS COLLEGE of CHEMISTRY

Instruction and preparation in CHEMISTRY and the EXPERIMENTAL SCIENCES under the direction of Professor E. V. GARDNER, F.A.S., M.S.A.

The Class Rooms are open from 11 to 5 a.m. and from 7 to 10 p.m daily.

Especial facilities or persons preparing for Government and other examinations.

Private Pupils will find every convenience.

Analyses, Assays, and Practical Investigations connected with Patents, &c., conducted.

Prospectuses and full particulars on application to Prof Gardner at Berners College, 44, Berners-street W.

THE CHEMICAL NEWS.

Vol. XLIII. No. 1119.

NOTES ON THE OXIDES OF MANGANESE.

By SPENCER UMFREVILLE PICKERING, B.A. Oxon, F.C.S.,
Assistant Master at Highgate School.

(Continued from p. 190.)

§ IV. *Experiment with Pure Oxides which had been Dried.*

All these oxides, as has already been mentioned, were prepared by the decomposition of manganese sesquichloride by water.

1. *Oxide No.* 4, after being washed, was dried in air at ordinary temperatures, by being placed under a bell-jar over some sulphuric acid. Subsequently it was ground in a mortar, and shaken through fine cambric in order to reduce it to as fine a powder as possible: it yielded on analysis the following numbers :—

MnO_2	61·545 per cent
MnO	8·342 ,,
H_2O	30·113 ,,

From which it is found that the total manganese present constitutes 45·342 per cent, of which—

$$\frac{\text{Mn as MnO}_2}{\text{Mn as MnO}} = \frac{85\cdot75 \text{ per cent}}{14\cdot25 \text{ per cent}} = 6\cdot02.$$

This oxide, as will be observed on an examination of Table IV., showed a very considerable loss of oxygen on being heated at 100° C., the only temperature at which any experiments were made with it.

2. *Oxide No.* 5.—This oxide was dried in an air-bath at 29° to 40° C., and sifted through cambric, like the preceeding and following specimens. Its composition was—

MnO_2	69·618 per cent
MnO	9·084 ,,
H_2O	21·298 ,,

Whence, total manganese present = 51·028 per cent, and—

$$\frac{\text{Mn as MnO}_2}{\text{Mn as MnO}} = \frac{86\cdot17 \text{ per cent}}{13\cdot83 \text{ per cent}} = 6\cdot239.$$

Here we find a very much smaller loss of oxygen is experienced on heating at 100° C. than in the former case, although the latter oxide contained rather more dioxide than the former, and might consequently have been expected to suffer a greater loss.

3. *Oxide No.* 6.—This oxide, after being dried in an air-bath at about 70° to 80° C., gave the following numbers on analysis :—

MnO_2	85·149 per cent
MnO	9·356 ,,
H_2O	5·490 ,,

And hence the total manganese present is 61·057 per cent, of which—

$$\frac{\text{Mn as MnO}_2}{\text{Mn as MnO}} = \frac{88\cdot13 \text{ per cent}}{11\cdot87 \text{ per cent}} = 7\cdot423$$

This oxide lost considerably more oxygen than the preceding sample, but not half as much as No. 4 did, although it was a good deal richer in dioxide than this latter. It will also be noticed that in this case the loss is not increased to any great extent by raising the temperature from 100° to 200° C.

§ V. *Experiments on Pure Oxides which had not been Dried.*

Since in the preceding cases oxygen was found to be evolved by these oxides at so low a temperature as 100° C., it was thought possible that they might have experienced a certain loss also, even at the temperatures at which they were dried, and, therefore, that if experiments were made on the oxides before any attempts whatever had been made to deprive them of water, a far more marked alteration might be effected on heating them. The only manner of experimenting on this point which suggested itself was one which gave little promise of success, but which, however, eventually proved to give very trustworthy results. It consisted in removing the hydrated oxide from the filter as soon as it had been thoroughly washed, and stirring it in a mortar with sufficient water to form a thin paste. Various portions of this paste, as nearly equal in amount as possible, were put into as many tared watch-glasses as were requisite for all the experiments on the samples in question; they were then weighed, and by weighing the last watch-glass full, both immediately before and immediately after weighing the rest, it was easy to obtain data by which the loss of water by evaporation during the weighing could be approximately allowed for. The errors to which this method of operating are obviously open were so far counterbalanced by taking a considerable amount for each experiment (5 or 6 grms.) that very fairly concordant results were obtained

Table IV.

Experiments on Dried Oxides obtained by the Decomposition of Mn_2Cl_6.

	Oxide.	Ratio of Mn as MnO_2 to Mn as MnO.	Conditions of Experiment.	Percentage of MnO_2 found, calculated on the unheated Oxide.		Percentage Alteration in the MnO_2 found.
67	No. 4*	6·02 : 1	Before heating	61·760	61·545	
68	,,	,,	,, ,, ...	61·320		
69	,,	,,	,, ,, ...	61·551		
70	,,	,,	After heating at 100° C.	60·066	60·032	2·458 per cent loss.
71	,,	,,	,, ,, ,,	60·033		
72	,,	,,	,, ,, ,,	59·997		
73	No. 5†	6·239 : 1	Before heating	69·791	69·618	
74	,,	,,	,, ,, ,,	69·545		
75	,,	,,	After heating at 100° C.	69·053	69·143	0·682 ,, ,,
76	,,	,,	,, ,, ,,	69·204		
77	,,	,,	,, ,, ,,	69·131		
78	No. 6‡	7·423 : 1	Before heating	84·939	85·149	
79	,,	,,	,, ,, ,,	85·359		
80	,,	,,	After heating at 100° C.	84·189	84·242	1·065 ,, ,,
81	,,	,,	,, ,, ,,	82·295		
82	,,	,,	,, ,, 200° C.	83·473	83·621	1·795 ,, ,,
83	,,	,,	,, ,, ,,	83·769		

* Dried over sulphuric acid in air and ordinary temperatures. † Dried in air at 29° to 40° C. ‡ Dried in air at about 70° to 80° C.

TABLE V.

Experiments on Moist Oxides obtained by the Decomposition of Mn_2Cl_6.

	Oxide.	Ratio of Mn as MnO_2 to Mn as MnO.	Conditions of Experiment.	Percentage of MnO_2 found, calculated on the unheated Oxide.		Percentage Alteration in the MnO_2 found.
84	No. 4	6·014 : 1	Before heating	4·095	4·102	
85	,,	,,	,, ,, ...	4·114		
86	,,	,,	,, ,, ...	4·097		
87	,,	,,	After heating at 100° C.	3·986	3·993	2·657 per cent loss.
88	,,	,,	,, ,, ,,	3·990		
89	,,	,,	,, ,, ,,	4·002		
90	,,	,,	,, ,, 200° C.	3·730	3·742	8·776 ,, ,,
91	,,	,,	,, ,, ,,	3·753		
92	No. 7	?	Before heating	4·616	4·619	
93	,,	,,	,, ,, ...	4·622		
94	,,	,,	After heating at 100 C°.	4·356	4·339	8·227 ,, ,,
95	,,	,,	,, ,, ,,	4·322		
96	,,	,,	,, ,, 200° C.	4·143	4·159	9·96 ,, ,,
97	,,	,,	,, ,, ,,	4·175		
98	No. 8	7·27 : 1	Before heating	13·014	13·107	
99	,,	,,	,, ,, ...	13·203		
100	,,	,,	,, ,, ...	13·103		
101	,,	,,	After heating at 100° C.	12·020	11·989	8·53 ,, ,,
102	,,	,,	,, ,, ,,	11·954		
103	,,	,,	,, ,, ,,	11·992		

in every case, as may be seen from an inspection of Table V. Thus for instance, in the case where the dioxide present in the sample amounted to about 4 per cent, the extreme variation of any one experiment on either side of the mean is 0·017 per cent, and the mean variation is only 0·0098 per cent, which corresponds to 0·245 per cent of the total manganese dioxide found, this being less than one-tenth of the minimum change in dioxide value which ever had to be measured, and about one-thirty-sixth of the alteration measured in most of the cases.

1. *Oxide No.* 4. This was the same oxide as one of the samples mentioned in the preceding paragraphs. It was formed to contain—

MnO_2 .. .. 4·102 per cent.
MnO .. .. 0·556 ,,
HnO .. .. 95·342 ,,

Whence the total manganese present is 3·023 per cent, of which—

$$\frac{\text{Mn as MnO}_2}{\text{Mn as MnO}} = \frac{85\cdot74 \text{ per cent}}{14\cdot26 \text{ per cent}} = 6\cdot014.$$

These last numbers, which are accidentally coincident with those above quoted, far within the limit of experimental error, show that the oxide was not appreciably altered, as far as manganese and oxygen were concerned, by being dried over sulphuric acid: moreover, on comparing the results given in Table IV. with those given in Table V., we see that the loss of oxygen which it experienced on being treated at 100° C. was practically the same both hefore and after being dried. This loss, in the case of the moist oxide, is more than trebled by raising the temperature from 100° to 200° C.

2. *Oxide No.* 7.—Of this oxide, unfortunately, no complete analysis was made, but from the Table it will be seen that the loss of oxygen which it experiences at 100° C. is nearly as great as that experienced by the previous specimen at 200° C., and that by raising the temperature up to this latter point the loss of oxygen is only increased by abouth one-fifth.

3. *Oxide No.* 8 gave the following analytical results:—

MnO_2 .. .. 13·107 per cent
MnO .. .. 1·471 ,,
H_2O .. .. 85·422 ,,

Whence the total manganese present constitutes 8·397 per cent, and of this—

$$\frac{\text{Mn as MnO}_2}{\text{Mn as MnO}} = \frac{87\cdot91 \text{ per cent}}{12\cdot09 \text{ per cent}} = 7\cdot270.$$

This oxide at 100° C. lost even more oxygen than the previous one.

ON THE DETECTION OF ARTIFICIAL COLOURING MATTERS IN RED WINES BY MEANS OF THE SPECTROSCOPE

By H. MACAGNO.

My last paper,[*] "On the Detection of Aniline Colours in Wines," will be perhaps of not much practical interest, because processes to ascertain their presence are already well known.

Although spectroscopic observation is a rapid and expeditious method to determine not only the presence but also the quality of the colours employed, the analyst would be easily mistaken in detection of aniline colours when to a wine containing *orseille* one of the ordinary processes is applied, as will be hereafter shown.

Artificial colouring matters—viz., hollyhock, cochineal, Portugal berries, bilberries, &c.—do not give such characteristic reactions as might be desirable for their detection. The tints produced by many reagents, as indicated in the handbooks of practical chemistry, do not react well; they are not well defined, and their detection is in consequence always uncertain. In such cases I think the spectroscope is very useful as a means of sure determination of the nature and quality of various tints resulting from different reactions.

I obtained in this way, with several colouring matters commonly mixed with red wines, a series of very characteristic and well-defined absorptions, œnolin being driven away by special treatments hereafter mentioned.

Orseille (lichen red).—This substance is soluble in ethylic and acetic ethers, and when aniline colours are sought for in a wine by ordinary processes, one can be led into a great error. But the ethereal solution observed by the spectroscope gives the following absorption[*]:—

5892<
5700 |
∞ |

Which evidently shows that aniline compounds are not the active agents here.

---

[*] Chemical News, vol. xliii., p. 169.

[†] See my last paper (*Ibid.*) on this means of representing absorptions and on the bands of aniline colours.

Another clearer reaction can be obtained in the following way:—To 20 c.c. of wine 10 c.c. of saturated solution of ammonium alum are added; and next 10 c.c. of sodium carbonate solution, 10 per cent (sp. gr. 1·039), are mixed with it, a dirty greenish precipitate is formed, and by filtration a violet-rose liquid is separated, which gives by spectrum analysis a characteristic band near D, and a hazy absorption in the violet, as follows:—

5892<
5817 |
5775 |
5700<
4860<
4505 |
∞ |

Hollyhock (*Althea rosea*).—When a wine containing some hollyhock is treated by ammonium alum and carbonate of soda, exactly as above, a violet liquid is obtained on filtration that produces the following spectrum:—

6550<
6520 |
6325 |
6150<
5225<
4860 |
∞ |

Portugal Berries (*Phytolacea*) *and Cochineal* can be easily detected by potassium alum and sodium carbonate. To 20 c.c. of wine are successively mixed 10 c.c. of potassium alum solution (10 per cent; sp. gr. 1·053), and 10 c.c. of the above-mentioned solution of carbonate of soda. The mixture passed through a filter gives a limpid and rose liquid, which produces different absorption-bands, according to the substance that is present.

Both phytolacea and cochineal produce these characteristic bands in the same place of the spectrum (viz., from D to *b*), but when the strength of the solutions is appropriate, two bands make appearance with the latter, and only one with the former:—

Portugal Berries.	Cochineal.
5850<	5850<
5625 |	5775 |
5400 |	5667 |
5134<	5562<
	5425<
	5325 |
	5225 |
	5134<

Bilberries (*Myrtille*).—The colouring matter of bilberries is identical with œnolin. I obtained always, and in different ways, perfectly equal reactions with both substances; and I do not think it possible to distinguish one from another. Bilberries, nevertheless, contain citric acid. the presence of which in wine would probably give a means of detecting this colour.

Indigo.—The best method of separating indigo is that indicated by Gauthier. A gelatine solution is mixed with wine; the precipitate formed is thrown on a filter, and washed with water and alcohol; indigo passes through the filter, and a blue colour appears in the washings. This liquid gives a characteristic absorption in the red, as follows:—

6705<
6550 |
6267 |
5362<

I employed in these researches Browning's miniature spectroscope with micrometer, which is a very convenient and complete portable instrument for taking rapidly the position of absorption-bands. Lamplight is preferable to daylight for this purpose, and liquids may be examined through ordinary test-tubes.

ERRATA.—In my paper on "The Detection of Aniline Colours in Wines," where the absorption-spectra of fucsine with methyl-violet and safranine with methyl-violet are indicated, *instead of* 5586 *read* 6100.

THE PHENOMENON COMMONLY CALLED THE "CRY OF TIN."

By J. C. DOUGLAS.

IF a piece of tin be bent it emits a sound; this, being regarded as a property peculiar to tin, has been termed "the cry of tin." This phenomenon is explained by the peculiar crystalline structure of the metal. If the explanation be the true one, then other metals which are obviously crystalline in structure should also exhibit the phenomenon under favourable conditions, but it is exceedingly difficult to place other metals in a crystalline state under proper conditions, *e.g.*, cast-iron and cast-zinc in thin rods break before they can be bent sufficiently to emit audible sounds, while rolled zinc has had its crystalline structure destroyed by rolling, and so is not in a condition to emit sound when bent. Rolled zinc is very tough as compared with cast-zinc, and its fracture is not crystalline, but of an even fine-grained bluish tint destitute of the brilliant lustre presented by this metal in a crystalline state. If, however, a piece of rolled zinc be heated for a few minutes to a temperature somewhat below its melting-point, the metal becomes much less tough, and its fracture is decidedly crystalline. On bending a piece of zinc so treated it emits a sound weaker than, but of the same nature as, the sound emitted by tin. Cast-zinc cannot be bent readily, but if it be pinched between the teeth, or with pliers, it emits the sound distinctly.

It appears, therefore, that the cry of tin is due to crystalline structure, that it is not characteristic of tin as generally accepted, but may be emitted by zinc and probably by other metals when crystalline in texture; that rolling in the case of tin and zinc, and probably in other cases, destroys the property with the alteration of texture; that in the case of zinc which has been rolled, the crystalline texture may be produced without melting the metal, but by merely heating it, and this is so readily done that it affords a ready illustration of the effects of high temperatures on rolled metal. If, as supposed, this sound is characteristic of the crystalline structure of metals, it may afford a means of great practical use whereby, by the sound a metal emits, we may draw conclusions as to its texture, and hence its fitness for certain purposes, or by the sound emitted by a beam when bent we may draw conclusions as to its safety, the microphone or other appliance being called in to aid us where the sounds are exceedingly weak.

Downing College, Cambridge.—Natural Science.—At the College Examination in June, 1881, in addition to the ordinary Foundation Scholarships, open exclusively to members of the College, one Foundation Scholarship of the annual value of £80 will be thrown open to all members of the University who have not kept more than six terms. The subjects of this examination will be, Chemistry (Theoretical and Practical); Physics (Heat, Electricity, and Magnetism); Comparative Anatomy, Physiology, and Botany. The examination for Minor Scholarships, which are open to all persons who have not entered at any College in the University, or who have not resided one entire term in any such College, will be held in Downing College, on Tuesday, the 31st of May next and three following days. Further information will be given by Mr. J. Perkins, or by the Rev. J. C. Saunders, Tutors of the College.

LONDON WATER SUPPLY.

Report on the Composition and Quality of Daily Samples of the Water Supplied to London, from March 21st to April 20th, 1881.

By WILLIAM CROOKES, F.R.S.,
WILLIAM ODLING, M.B., F.R.S., F.R.C.P.,
Professor of Chemistry at the University of Oxford;
and C. MEYMOTT TIDY, M.B., F.C.S.,
Professor of Chemistry and of Forensic Medicine at the London Hospital; Medical Officer of Health for Islington

To the Right Honourable the President of the Local Government Board.

April 21, 1881.

Sir,—We again beg leave to hand you the results of our examinations of the water supplied to the Metropolis for the month ending April 20th.

The circumstances under which the examinations have been made and the precautions taken to secure trustworthy results are similar to those we have described in our previous reports. The samples have been collected from the localities named in our last report.

As regards turbidity and colour a further improvement has taken place in the Metropolitan waters since the date of our last report. Of the 161 samples examined during the month, in 5 only was a trace of suspended matter recognisable.

The method of determining the colour of the water, given in detail in our last report,* has been continued this month on the whole of the samples collected from all the Water Companies. The results are given in Table II. The notation employed having been fully explained last month, need not again be given.

In Table I. we have recorded the analyses in detail of samples, one taken daily between March 21st and April 20th. The purity of the water in respect of organic matter has been determined by the Oxygen and the Combustion processes, and the results of our analyses by these methods are stated in columns XIV. to XVIII.

In Table II. is recorded the colour by the method above described, together with the clearness or turbidity of each sample. Of the 161 samples collected by us between the dates mentioned above, 156 were found "*clear*," and 5 were noted as "*very slightly turbid.*"

Of the 23 samples supplied by the New River Company, the whole were, without exception, clear, bright, and efficiently filtered.

Of the 23 samples rom the mains of the East London Company, 4 were noted as "very slightly turbid." The remainder were bright, clear, and well filtered.

Of the 23 samples from the mains of the Chelsea Water Company, the whole were bright, clear, and well filtered.

Of the 23 samples from the mains of the West Middlesex Company, the whole were clear, bright, and well filtered.

Of the 23 samples from the mains of the Lambeth Water Company, the whole were clear, bright, and well filtered.

Of the 23 samples from the mains of the Grand Junction Company, the whole were clear, bright, and well filtered.

Of the 23 samples from the mains of the Southwark and Vauxhall Company, one only was noted as "very slightly turbid." The remaining 22 samples were clear, bright, and efficiently filtered.

When a trace of suspended matter is noticeable, we record the water as "turbid." When on close scrutiny we are able to detect any suspended matter whatever, we call the water "very slightly turbid." A water is recorded as "slightly turbid" when we consider it to come between those two extremes.

In Table III. we have recorded the oxygen required to oxidise the organic matter, and the quantities of free oxygen in the whole of the 161 samples collected.

The improvement we had occasion to mention as having taken place in the appearance of the Metropolitan waters in our last report, has been still further noticeable during the past month, and taken as a whole, they leave nothing to be desired in respect of colour, wholesomeness, complete aëration, or absence of suspended matter.—We remain, Sir, your faithful servants,

William Crookes,
William Odling,
C. Meymott Tidy.

ON A SIMPLE FORM OF APPARATUS FOR DETERMINING THE SPECIFIC HEATS OF SOLIDS AND LIQUIDS WITH SMALL QUANTITIES OF MATERIAL.

By J. W. MALLET, F.R.S.

Both of the most trustworthy forms of apparatus hitherto in use for the determination of specific heat—those of Regnault and Bunsen—are somewhat troublesome to prepare for an experiment, the latter notably so. Regnault's calorimeter requires a fresh measurement of the water for each occasion of use, and gives accurate results only with considerable quantities of the materials to be examined,* so that in the case of rare substances, of which but a few grms. can be had it ceases to be available. Bunsen's ice calorimeter, beautiful as the instrument is in principle, and capable of being applied to but a fraction of a grm. of material, can be repeatedly used within a few hours, or at most days, after it has been packed in snow or shaved ice; but when longer set aside, demands, as has been said, no small care and trouble to get it again ready for use.

An arrangement which shall avoid these disadvantages, which shall be simple, and capable of immediate use after having stood aside for weeks or months, which shall work with but little of the material under examination, and which shall give results not necessarily equal in accuracy to the best that may be obtained by more elaborate methods, but accurate enough for the ordinary application to be made by the chemist of a knowledge of specific heat, as bearing on atomic or molecular weight, seems likely to be useful, and may serve to render approximate determinations of this physical constant more frequent, in something the same way that the apparatus of V. Meyer has facilitated the determination of vapour density.

Fig. 1 shows in elevation the general appearance of a little calorimeter which I have found to fairly fulfil these conditions; the figure is from a photograph, and of about one-sixth the linear dimensions of the original. The base, A, and two uprights, B B, are made of hard wood. The cylindrical body, C, of the calorimeter is mounted upon two brass pins, D, passing through the opposite uprights, so that it can be turned round an axis at right angles to its axis of figure. A cross-piece of wood, E, serves to rest the fingers upon in grasping C at the time of use, and elastic bands of india-rubber are stretched across between the uprights to prevent the accidental breaking of the thermometer, F, by violent swinging round of C, from which it projects. An upright arm, G, bears upon it two corks, H I, between which the thermometer moves, and the distance apart of these corks determines the extent of motion of rotation of C during use. The arm, G, itself turns on a pin screwed in to the end of the base, so that it (G) can, when necessary, be turned back out of the way of the thermometer which can then move further up or down. Two little blocks of wood, K K, respectively in front of and behind the lower end of G, serve as stops to regulate the throwing it into posi-

---

* The composition of the blue solution should be 5 grms. of pure crystallised sulphate of copper in one litre of distilled water, instead of 10 grms. as given last month.

* Several hundred grms. were used in each of a large number of Regnault's own experiments.

tion or back out of the way as required. A reading lens, L, is arranged upon a cork support to slide upon the stem of the thermometer at a proper distance from its scale, and error of parallax is avoided by a short tube above the lens with a small hole in the upper end to sight through.

Fig. 2 presents a longitudinal section of the body (C in Fig. 1) of the calorimeter of one-half the real linear dimensions. The outer cylinder *a* is a tube of hard india-rubber (vulcanite),[*] 105 m.m. long by 64 m.m. in diameter inside, 1·5 m.m. thick. The ends are round plates of the same material and thickness, and screw down over the extremities of the tube. The inner cylinder *b* is also a vulcanite tube of the same thickness, 22 m.m. in interior diameter, passing snugly through a simple round hole in one end plate of the outer cylinder and screwing into a corresponding hole in the plate closing the other end.[†] The space between the inner and outer cylinders is uniformly but loosely filled with delicate turnings of vulcanite. Both ends of *b* are closed by very accurately fitted corks of the finest texture, free from all hard lumps, flaws, cracks, or irregularities of surface. Through one of these corks, *c*, passes the stem of a mercurial thermometer, *d*, specially made for this instrument, the scale bearing centigrade degrees of 6 m.m. long, divided to tenths, and reading easily by estimation to twentieths of a degree, the scale running from 5° to 40° outside the cork.[‡] The other cork, *e*, is solid. The length of the inner cylinder, *b*, is divided into two unequal parts by a diaphragm, *f*, of vulcanite of the same thickness with the tube itself, situated 47 m.m. from the end bearing the thermometer, and 59·5 m.m. from the other end. This diaphragm is fixed in its place by three very small screws of vulcanite passing through the wall of the tube, and has in the centre a round hole, *g*, of 7 m.m. in diameter. At three points equidistant from each other round this hole three bits of hard-drawn platinum wire, *h*, each 37 m.m. long and 0·35 m.m. diameter, are firmly inserted on the side next the unperforated cork, their lower ends curved inward and their free ends sprung apart, so that the little platinum cylinder, *i*, when dropped down between them, is grasped firmly enough to retain its place though the tube be inverted, and is supported exactly in the middle of the surrounding space, at equal distances from the inner surface of the tube, from the diaphragm, and from the cork *e*. The platinum cylinder, *i*, intended to contain the substance whose specific heat is to be determined, 28·5 m.m. long by 12·5 m.m. diameter, stiff enough, and slightly drawn in at the open end, so as to be securely closed by the cover, *k*, while the two together weigh only a little over 6 grms. The supporting platinum wires weigh about 0·5 grm. A ring of cork, *l*, 28 m.m. wide and 5 m.m. thick, encircles the outer cylinder, *a*, at the middle of its length, and is itself firmly grasped by a ring of hard wood, *m*, 12·5 m.m. wide and 5 m.m. thick, in which, at two opposite points of the circumference, are the holes *n n*, entered by the brass pins on which the whole turns. A weighed quantity of pure mercury—as I have used the instrument, about 220 grms.—is placed in *b*, and can be shifted from one division of this cylinder to the other through the hole *g*, as by rotation on the bearings, one end or the other is brought uppermost.

Fig. 3—to same scale as Fig. 1—illustrates the mode of heating, to the temperature of a current of steam, the specimen of material whose specific heat is to be determined. A is a ring, sliding on and fixed at a convenient height on the upright rod of a filter stand, by which the flask B is supported over a lamp. B contains the supply of water for conversion into steam, the steam being carried by the india-rubber tube C into the lower end of the large glass tube D, from the upper end of which it escapes by the india-rubber tube E. The smaller glass tube F, closed at the bottom and placed concentrically within D, serves to contain the little platinum cylinder holding the specimen under examination. A large ring of cork, G, forms a handle, by which D may be taken up without burning the fingers, and during the heating this ring rests on the forked support H. The india-rubber tube, I, carries off water as condensed in D to the glass cylinder, K. The tubes C and I are long enough to allow D to be lifted clear of its support and moved a foot or so without disturbing the rest of the apparatus, and without any interruption of the current of steam through D.

Fig. 4—to a scale of one-half the real linear dimensions—gives a vertical section of the heating-tube (D of Fig. 3) and its appendages. In this figure *a* is the outer glass tube, 145 m.m. long and 45 m.m. inner diameter, closed at top and bottom by corks *b* and *c*. Through the lower cork pass two bits of glass tube, each of 5 m.m. bore, the one connected with the india-rubber tube *d* (C of Fig. 3) for the introduction of steam, the other leading to the tube *e* (I of Fig. 3), also of india-rubber, intended to drain away condensed water. The small bit of glass tube, *f*, also of 5 m.m. bore, passing through the upper cork, leads to the india-rubber tube *g*, about 140 m.m. long, and serves for the escape of uncondensed steam at such a distance as to avoid any risk of either steam or drops of hot water getting into the calorimeter at the moment of transferring to it the platinum cylinder. The inner glass tube, *h*, is 15 m.m. in diameter inside and 107 m.m. long, closed at the lower end, and ground off squarely to a smooth edge at the top. It contains the little platinum cylinder *i*, holding the specimen to be heated. After the introduction of this cylinder a loose plug of carded cotton fibre, *k*, is pushed into the mouth of *h*, which is then closed by a cover or lid formed of a piece of, *l*, with a smooth lower surface, and carefully fitted so as to come down flat upon the mouth of the tube. *l* is attached to the long arm *m* of a little lever of wood, pivoted in a forked support at *n*, and capable of being very rapidly thrown over backward by momentary pressure of the thumb on the short arm *o*, thus completely clearing the mouth of the tube *h*. *l* is weighted by a little piece of lead (a flattened buckshot) of 5 or 6 grms. imbedded in the cork at its junction with *m*. *p* is a large cork ring, 18 m.m. wide and 10 m.m. thick, serving as a handle for *a*, and as a shoulder by which it may rest on the forked support of the stand shown in Fig. 3. An outer jacket of stiff paper, containing cotton fibre or swan's down, may be placed round the glass cylinder *a* during the heating, but this, for the sake of clearness in the figure, is not shown.

The preliminary observations are as follows:—It is first ascertained to what extent the temperature of the mercury in the calorimeter is raised by the metal running down from one end of the inner tube to the other during a given number of turns of the calorimeter on its bearings, the amount of motion in each direction being limited by the distance between the two corks (H and I of Fig. 1) which the thermometer stem touches at the top and bottom of its arc of movement. The rise of temperature is very small, as may be easily calculated from the extent of fall of the mercury, and is diminished by a part of the heat produced being absorbed by the vulcanite, the platinum, and the material of the thermometer. Thus the actually observed rise of temperature was found to be but 0·06° C. for 100 *single* movements of the calorimeter, each transferring the mercury once from end to end of the tube. During this and all other experiments with the calori-

---

[*] This material was selected on the ground of its remarkably low conducting power, a fact which has been strikingly brought out by the comparative measurements of J. Stefan (*Wien. Acad. Ber.* (2 Abth.), 74, 438-462). He finds, for example, that the true heat-conducting power of vulcanite is several times less than that of ordinary glass, whether considered for equal volumes or equal weights.

[†] This inner cylinder might with advantage have been made somewhat smaller, best by shortening both cylinders a little and shifting the diaphragm somewhat toward the end containing the enclosed thermometer.

[‡] As the temperature to which the substance to be examined is raised is determined directly from the boiling-point of water under known barometric pressure, the absolute value of the scale of this thermometer, with which the temperature of the mercury in the calorimeter is determined, ought to be known. Comparison with a good standard instrument showed that such errors as exist are too small to sensibly influence the approximate results, which alone can be obtained with the apparatus under notice.

meter it is kept in a large room of as steady temperature as possible and free from strong draughts of air.

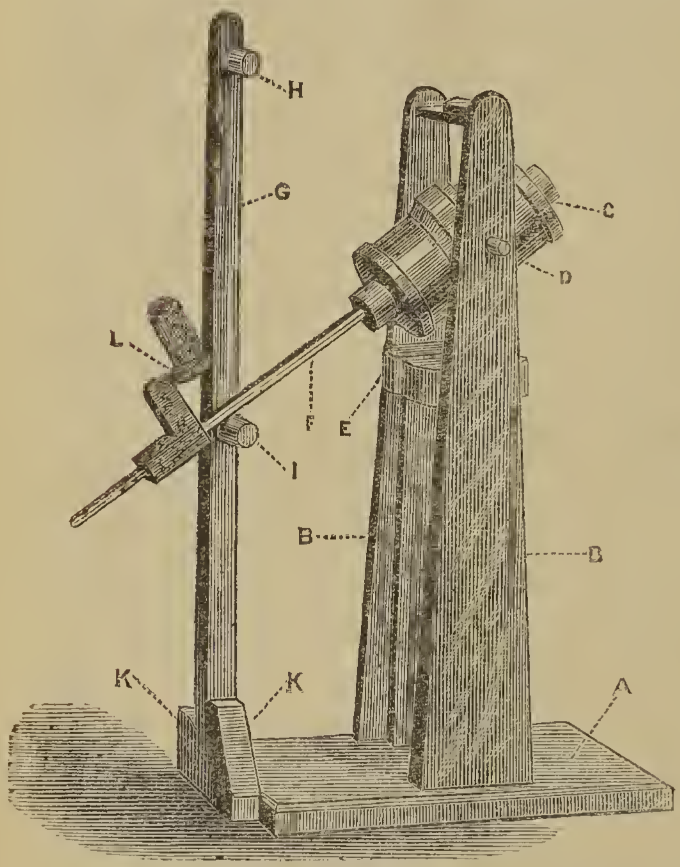


Fig. 1.

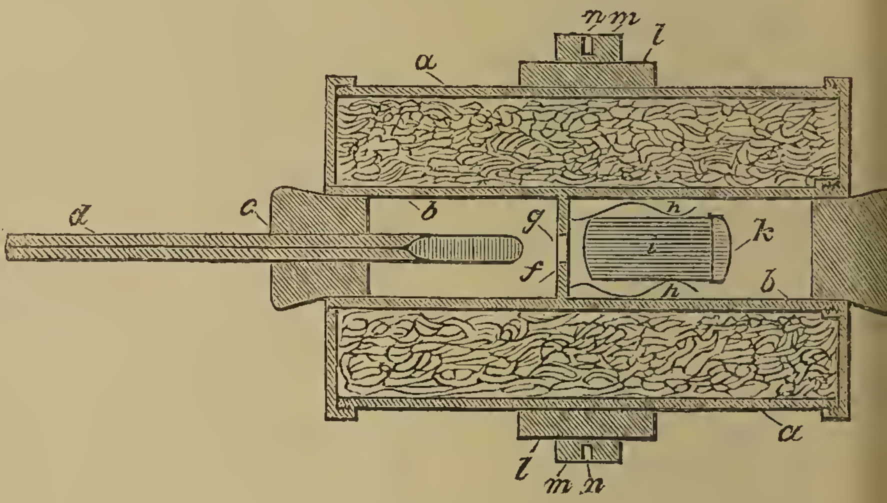


Fig. 2.

The little platinum cylinder (*i* of Fig. 2) is now transferred to the bottom of the inner tube of the heating-apparatus (*h* of Fig. 4), in which it rests upside down, the loose plug of cotton-wool (*k*) is inserted in the mouth of the tube *h*; over this the cork cover (*l*) is brought down, and, the connecting tubes being in position, a lamp is placed under the flask of water, and the water boiled actively, but not so violently as to produce difference of pressure inside and outside the heating tube, thus sending a brisk current of steam steadily through the outer tube for half an hour or an hour, preliminary experiments with a small thermometer in the inner tube having shown that this is time enough to bring the contents of the tube closely up to the true temperature of the steam: the difference of temperature between the steam and the material to be heated was never found to be nearly as great as 1° or 2°, observed by Regnault in his experiments. The barometer and attached thermometer are now read, in order to admit of afterward calculating the true temperature of the steam. A few moments before the platinum cylinder is needed, the plug of cotton is quickly withdrawn, the cork cover dropped back to its place, and the current of steam somewhat increased by raising the lamp flame. The calorimeter, which has previously been kept in a part of the room far enough away from the heating-apparatus not to be sensibly affected by it, is now brought near to it, the thermometer is read and the reading recorded, the arm (G in Fig. 1) thrown back out of the way, the cylinder C—held lightly but firmly with the left hand—is brought nearly upright, with the thermometer downward, the upper cork (*e* of Fig. 2) loosened in its seat with the right hand so that it may be easily taken out, and then held ready for removal with the thumb and first finger of the left hand. The heating tube (D of Fig. 3) is lifted from its support by the cork ring (G), which is placed as in a fork between the second and third fingers of the right hand, the palm of this hand being upward and the thumb lightly resting on the short arm (*o* in Fig. 4) of the little wooden lever which carries the cork cover, *l*. The current of steam is not interrupted while the upper end of the tube (*h* of Fig. 4) is being brought close to the mouth of the calorimeter tube, and then, by quick simultaneous movements with both hands, the cork is momentarily withdrawn from the latter tube, the right thumb is pressed down so as to throw back the cover of the heating tube, and this tube is tilted so as to drop the platinum cylinder down into the calorimeter, where it is held in its central position by the elastic grasp of the three bits of platinum wire. The cork of the open end of the calorimeter is instantly replaced by the finger and thumb of the left hand, and the right hand used to insert it more firmly as soon as the heating tube has been quickly put back upon its support. The calorimeter is now carried back to its place in a distant part of the room, raising as it is carried the thermometer until it is between the two corks of the movable arm, G, this arm being brought forward into position, and the body (C) of the instrument is gently turned* alternately up and down at such a rate as experience has taught will just allow the complete transfer of the mercury from one division of the tube to the other between the reversals, until the thermometer indicates that the maximum temperature due to the introduction of the heated platinum has been reached. A little practice soon teaches one to guess at about the time necessary for this, and the cylinder may then be stopped for a moment to allow of accurate reading, resuming the motion immediately afterward in order to see whether any further rise of temperature occurs. The loss of heat from the vulcanite is so slow that ample time is afforded for accurate observation of the thermometer. As an additional security, however, against the true maximum temperature being overlooked, it is convenient to have a little detached cylinder of mercury in the thermometer tube as an index, like that of the common maximum registering thermometer, but reading from the head of the main column, and using the index merely to assure oneself that the reading is made before the temperature begins to fall. The number of swings made by the calorimeter has been

---

* The projecting part of the solid cork *e* is used as a handle.

counted as it was turned. A comparison of the initial temperature of the mercury with that finally reached after the introduction of the platinum cylinder gives the heating effect of the latter plus that due to the agitation of the mercury, as previously determined, for the number of swings made. Subtracting the latter, and after several repetitions of the experiment taking the mean of the results, reduced to the same interval of temperature passed through by the platinum,* the practical effect of the latter in heating the mercury, while itself cooling a given number of degrees, is known.

If now the specific heats of two solid bodies are to be compared, a specimen of each in succession is accurately weighed off, enclosed in the platinum cylinder, raised to the temperature of the steam in the heating apparatus, transferred to the calorimeter, and the effect upon the temperature of the mercury observed, precisely as in the experiment above described with the empty platinum cylinder. Aside from the time occupied in heating up the specimen to be examined, an experiment takes but two or three minutes. It is desirable to take such a quantity of the substance as shall occupy the greater part of the capacity of the cylinder, since otherwise, if the platinum cover be not tightly fitted on, a little mercury may be forced into the cylinder in consequence of the contraction of the enclosed air as it cools down. Good results have been obtained, however, with quantities ranging from 0·8 grm. up to 25 grms. From the heating effect produced in the calorimeter in each experiment is to be deducted that due to the platinum cylinder for the interval of temperature passed through, and to the agitation of the mercury for the number of turns made of the body of the instrument. If the second experiment follow immediately after the first there will generally be little difference between the initial temperatures and final temperatures respectively of the bodies examined; but of course the results are always to be reduced by calculation to the same interval passed through.

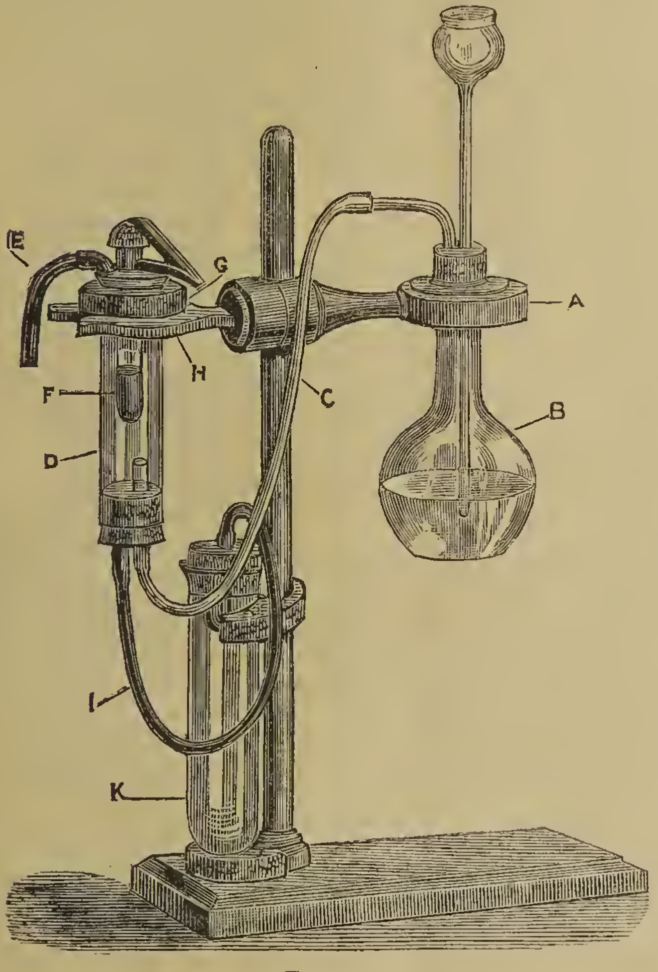


Fig. 3.

To restore the temperature of the calorimeter quickly after an experiment to that of the room, or very near this, a separate cork is provided, to take the place of *e* in Fig. 2, through which passes a sealed test-tube containing mercury. This mercury is cooled a good deal below atmospheric temperature by immersion of the test-tube for a little while in a larger quantity of mercury contained in a beaker, and either placed out of doors in cold weather or surrounded by ice-water. On inserting the cork in its place at the end of the inner cylinder of the calorimeter, and turning the body of the instrument up and down a few times, the tube of cold mercury reduces the temperature of that which surrounds it until the thermometer reads a little below the temperature of the room. Removing the cold mercury tube and cork, replacing the latter by the solid cork *e*, turning the end of the calorimeter downwards, taking out the thermometer from the other end, to cool it in like manner by immersion of the bulb in cold mercury, and to set the index, and then replacing it, turning the thermometer end down again, taking out the cork *e*, and allowing the instrument to stand for a little while with the inner cylinder open, the temperature of the room is fully recovered.

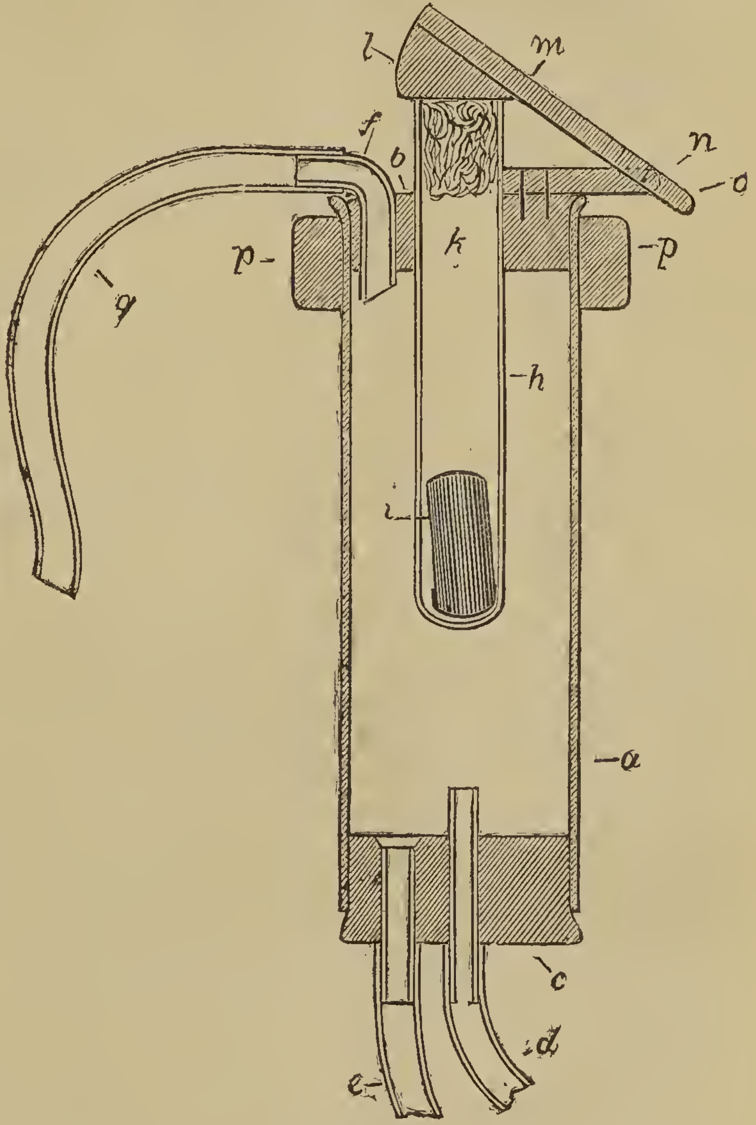


Fig. 4.

In no case is the whole heating effect of the platinum cylinder and its contents expended upon the mercury, a portion of the heat going to raise the temperature of the vulcanite, the end corks, the little platinum wires, and the enclosed portion of the thermometer. But the character and quantity of all these substances sharing in the recep-

---

* The specific heat of platinum, as of mercury, may of course be considered as uniform within the range of variation of the temperatures employed.

A. Substance examined.	B. Substance used for comparison.	C. Specific Heat assumed for Substance in Col. B.*	D. Spec. Heat found for Substance in Col. A.	E. Specific Heat previously recorded for Substance in Col. A.*
Silver	Platinum	0·0323†	0·055	0·057 (Regnault)
			0·058	0·056 (Kopp)
			0·057	0·0559 (Bunsen)
Copper	,,	,,	0·090	0·0951 (Regnault)
			0·098	0·093 (Kopp)
				0·0924 (Wüllner)
Iron	,,	,,	0·110	0·1138 (Regnault)
			0·106	0·112 (Bunsen)
			0·110	
Mercury	,,	,,	0·032	0·0333 (Regnault)
			0·034	0·0337 (Winkelmann)
			0·033	0·0334 (Petersson and Hedelius)
			0·032	
			0·031	
Ferric oxide (specular iron)	Calcium carbonate (Iceland spar)	0·2073‡	0·159	0·1669 (Regnault)
			0·165	0·166 (Neumann)
			0·163	0·154 (Kopp)
Barium sulphate (heavy spar)	,,	,,	0·109	0·1128 (Regnault)
			0·104	0·108 (Kopp)
				0·1088 (Neumann)
Potassium nitrate (cryst.)	Sodium chloride (cryst.)	0·2150§	0·226	0·23875 (Regnault)
			0·238	0·232 (Kopp)
				0·2343 (Neumann)
Cane sugar (cryst.)	,,	,,	0·298	0·301 (Kopp)
			0·292	
Ethyl alcohol	Water	1·0044‖	0·628	0·6769 (calc. from Regnault)
			0·640	0·6138 (Schüller)
			0·637	0·6273 (Dupré and Page, cor. by Schüller's formula)
				0·66885 (calc. from Winkelmann)
Sulphuric acid	,,	,,	0·368	0·343 (Kopp)
			0·355	0·3542 (Pfaundler)

* Where the authorities referred to for the numbers in these columns give the means of ascertaining the specific heat for the particular range of temperature involved in my experiments, this number is quoted.

† 0·0323 (Violle), 0·0324 (Regnault).

‡ 0·2086 (Regnault), 0·206 (Kopp).

§ 0·2140 (Regnault), 0·216 (Kopp).

‖ 1·0039 (Henrichsen), 1·005 (Regnault).

tion of heat being constant, and the circumstances under which heat is given off and received being rendered practically uniform, a large and nearly a constant fraction of the whole heating effect is expended on the mercury, so as to render the results as obtained practically useful measures of the heat given out by the cylinder and its contents. The rate at which heat is taken up from or given off to surrounding matter by the well-protected mercury in the calorimeter is so slow, the greatest difference of temperature which need exist between the interior and exterior is so small, and the time necessary for an experiment is so short,—but two or three minutes,—that the correction employed by Favre for the rate at which the mercury in his calorimeter was heating or cooling from without during an experiment (obtained from observations before and after) need not be, although of course it might be, applied.

The quantity of the substance taken for examination may conveniently be such as to produce a rise of temperature of the mercury to the extent of 5 or 6, or at most 8, degrees, and if the specific heat of the substance can be guessed at, or be roughly determined in a first experiment, greater accuracy may be attained by taking such weights of the substance itself, and of that with which it is to be compared, as shall produce very nearly the same heating effect. If the initial and final temperatures shown by the thermometer be made the same, or nearly the same, in successive experiments, the correction for the portion of the stem outside the calorimeter becomes constant, and so may be neglected in this merely comparative method. Further, instead of comparing the effect in every case with that of a single standard body, I prefer to take for comparison any substance of which the specific heat is already well determined, and whose general character, as regards specific gravity, conducting power, &c., resembles that of the substance of which the specific heat is to be examined, thus using for the purposes of comparison with substances of analogous character such bodies as platinum, mercury, calcareous spar, sodium chloride, water, benzene, &c. The substances compared should be, as far as possible, in the same state of compactness or subdivision. When a liquid is to be examined the specimen is enclosed in a tube of very thin glass, as nearly as possible filling the platinum cylinder, and with a drop of mercury used to close up the greater part of the space round the side and bottom, the heating effect of the kind and weight of glass used being determined beforehand, and the platinum cylinder with its contents weighed on withdrawal from the calorimeter, so as to prove that the little drop of mercury inside has not been increased by any of that in the calorimeter, or diminished by any escaping into the latter. Care is to be taken that in all respects—prevailing atmospheric temperature, quickness of manipulation, &c.—the conditions of comparison be made as nearly as possible the same. This is rendered easy by the short time required for the experiments.

The two main features peculiar to the little calorimeter now described are simply the employment of mercury instead of water as the liquid to be heated, and the comparison, not of the total amounts of heat given out by different bodies in cooling, but of fractions of the same rendered as nearly as possible equal.

The employment of mercury as the material whose temperature is to be raised by the heat given out by the substance experimented on has certain advantages:—1st. For equal bulks mercury experiences 2·2 times the increase of temperature that water does for the same amount of heat received. The volume of mercury used may therefore be made quite small while retaining command of sufficiently accurate reading of the change of temperature produced. 2nd. The superior conductivity of mercury and its low specific heat facilitate the transfer of heat from the cooling body, shortening the time of the experiment, and thus diminishing the loss of heat through the solid material of the calorimeter, whose properties in the respects mentioned are, as they should be, the reverse of those of the mercury. 3rd. Mercury does not sensibly vapourise at such temperatures as are required for the purpose in question, and hence no loss of heat on this account is to be feared. In experiments like those of Regnault, if made with a small quantity of water in an open vessel, the error due to evaporation, and consequent loss of latent heat, may become considerable, or may require for correction troublesome repetition of weighings of the water used. 4th. For the same reason the original quantity of mercury taken remains unchanged, and hence the instrument is always ready for use. To secure this convenient condition the inner cylinder of the calorimeter is only to be opened with caution, over a little tray of glazed cardboard, and any globules—even the most minute—of mercury which may be found adherent to the corks, thermometer bulb, or cold mercury tube, are to be swept together, as is easily done with a small camel's-hair pencil, and returned to the cylinder.

This application of mercury is to be distinguished from that involved in the calorimeter of Favre and Silbermann, and in that recently described by Prof. Stewart* and Messrs. Gee and Stroud,† in both of which the expansion of mercury in the calorimeter itself is directly measured, and used to determine the rise of temperature.

As regards the second peculiarity of the instrument now described, it is obvious that, in any arrangement for measuring the heat given out from one body in cooling by applying it to raise the temperature of another, it is impossible to prevent loss by conduction and radiation, and by making the vessel of material of high conducting power, and counting it in with its contents, the difficulty is but shifted from the inside to the outside of its walls. On the other hand, it is clearly not necessary that the whole amount of heat given out by the cooling body be obtained in measurable form; it would come to quite the same thing (as far as the determination of specific heats is concerned) if we could secure the measurement in all cases of a constant fraction of it. It is not pretended that this latter result has been fully secured in the apparatus now described, nor is its use proposed as a general substitute for more exact methods, but that it is capable of giving a very fair approximation to such result is, I think, shown by the following examples of determinations of specific heat which have been thus obtained. The figures are not carried in calculation beyond three places of decimals (See Table, page 208).

CORRESPONDENCE.

THE ESTIMATION OF PHOSPHORUS IN STEEL.

To the Editor of the Chemical News.

Sir,—In the Chemical News, vol. xliii., p. 186, there appears a criticism of my paper on the estimation of phosphorus in steel by a correspondent who signs himself "Phosphorus." If "Phosphorus" would explain what there is "astonishing" about the "device" of introducing a known amount of pyro-phosphate, and re-estimating it, I should be glad.

The salt was added to the dry oxide obtained from the first evaporation, and was dissolved in concentrated HCl, so that any speculation your correspondent may have indulged in as to its ultimate conversion to ortho-phosphate was unnecessary, as under the circumstances it would undoubtedly be converted into the normal phosphate.

"Phosphorus" refrains from "going into detail," and contents himself with the vague statement that my results are almost all open to exception." He then proceeds to sum up my errors in the manipulation of the molybdate process under three heads.

In the first he takes exception to the term "moderate excess," and perhaps the words are somewhat ambiguous, as indeed are the words "very *large* excess." However, I can soon dispose of the first count in the indictment by informing "Phosphorus" that the amount of strong molybdate reagent used throughout the experiments was 50 c.c., an amount which all will admit to be ample.

"Phosphorus" next points out that the molybdate process when carried out in the presence of chlorides (which is very often the case in a rapid estimation, the solution being evaporated only once with HNO_3), is not reliable. "Phosphorus" speaks of evaporating to low bulks "several times," as though any consideration of time was quite out of the question. This same indifference is exhibited in count three, where he speaks of a "much longer time" than two hours being necessary. The allowance of time "Phosphorus" regards as one of "the most important conditions of success," and then in his next words he admits that in the presence of a "hastener" this condition is neglected. Did "Phosphorus" notice that in subsequent experiments I tried the molybdate process under every possible condition, and with all the precautions he states I neglected? Did "Phosphorus" observe that I pointed out that the results obtained by getting rid of chlorides (in a shorter and more effectual way than by mere evaporation with HNO_3), were higher than the results obtained when the process was carried out hurriedly? If the molybdate process be carried out with all precautions it is still low, and occupies a much longer time than the modified method. If it is carried out in a hurried manner the results are obtained quickly, but are of little value. Further experience with the modified process has shown that it can be carried out as quickly as the rapid molybdate method, as the precipitate may be filtered off in less than an hour, after adding the magnesia salt.

"Phosphorus" assumes that I get down the correct weight of the definite salt of phosphorus, and convert it into the magnesia salt, whereas I distinctly stated that in order to get down the whole of the phosphoric acid, the solution was boiled, and free molybdic acid was obtained in addition to the phospho-molybdate, and that it is to get rid of the MoO_3 the phosphorus is re-precipitated with magnesia. If it can be proved that the *whole* of the H_3PO_4 can be precipitated as phospho-molybdate without bringing down free molybdic acid (which I hold as most uncertain), then undoubtedly it is preferable to weigh as yellow salt on account of the small amount of phosphorus it contains, though at the same time it is a troublesome precipitate to deal with compared with the pyro-phosphate. Again, if it can be shown (and I maintain it to be the case) that in spite of the advantage of the molybdate precipitate compared with the magnesia precipitate in point of the percentage of phosphorus, the molybdate yields low results, the fact becomes a powerful argument against the process.—I am, &c.,

J. Oliver Arnold.

Sheffield, April 28, 1880.

METHOD OF TESTING THE VALUE OF INSOLUBLE PHOSPHATES.

To the Editor of the Chemical News.

Sir,—Of all the curious methods which have been proposed for determining by chemical processes the commercial value of natural or manufactured substances, none seem to me more strange and unsuitable than the method of testing the value of insoluble phosphates, whether reverted or not, in superphosphate by means of citric acid. These insoluble phosphates will not come under the influence of citric acid in the soil, and therefore their solubility in that acid can be no proper test of their industrial value. A much more natural plan would be to determine their

---

* *Proc. Manchester Lit. and Philos. Soc.*, March 4, 1879.
† *L., E., and D. Philos. Mag.*, Sept., 1880, p. 171.

solubility in a solution of definite strength of ammonic sulphate or chloride, or one of sodic chloride. A good many years ago one of my evening students determined the relative solubility of the insoluble phosphates in different manurial substances in solutions of sodic chloride and salts of ammonia of different strengths, and his investigation proved that when tested by what may be termed one of these natural processes, these phosphates have different industrial values.—I am, &c.,

Robert Galloway.

Dublin, May, 1881.

BENZOL TESTING.

To the Editor of the Chemical News.

Sir,—In the Chemical News, vol. xliii., p. 186, appears a letter from Mr. W. W. Staveley, in which he accuses me of unjustly criticising his previous letter. He gives an example of that unjust criticism thus: It is not fair to say simply "that he obtained 37 per cent of distillate from a 30 per cent benzol when the temperature did not rise above 97° C.," but it would, according to Mr. Staveley, be fair if I had added that the experiment was made in an apparatus similar to the one suggested by me in my first letter, and that it took one and a half hours for the distillate to come over. If these points had been of importance to the question at issue, they would have been mentioned, but they are not. Mr. Staveley, as a "specialist," has the idea deeply impressed on his mind that time and kind of apparatus are important factors in benzol testing. He says he ought to know all about benzol testing, because he has had many years experience in a large benzol refinery. I do not wish to reflect upon the intelligence of Mr. Staveley when I say that the same argument would prove that an experienced navvy should be an excellent engineer. But Mr. Staveley no sooner relies upon the value of his experience than he shows that it does not mean much, for he now acknowledges that "J. D." (the gentleman he ridiculed in his previous letter) has taught him something, and he is now pleased to reconsider the process as a whole which a short time ago he regarded as infallible.

The question of lengths of thermometer bulbs is of no importance. In my criticism of Mr. Staveley's letter I cited it as an example of his rhetoric. He does not deny that thermometers are commonly sold and used, the bulbs of which vary from ⅝ths to 1 inch or more in length, which he acknowledges to be a great difference, but he does deny that persons testing benzols throughout the country use thermometers, the bulbs of which vary materially in length; thus we have a combination of three extraordinary circumstances. First, that there is a divinity which must have told benzol testers what lengths the bulbs of their thermometers ought to be. Second, that Mr. Staveley has the extensive acquaintance of most of the persons throughout the country who test benzols; and third, that, if the second be granted, he is a man of extraordinarily acute observation, and possesses a marvellous memory that he should, without having any object for doing so, *observe* and *remember* the sizes of the bulbs of the thermometers of his numerous friends.

If open Bunsen flames be used in benzol testing, independently of the form of apparatus employed, it will be next to impossible for two persons, testing the same sample (especially if they don't know previously what, according to Mr. Staveley, it *ought to give*), to obtain the same result. The test is made by applying an open flame to the apparatus containing, say, 100 c.c. of the sample, and the temperature is allowed gradually to rise to 100° C., when the flame is withdrawn and the distillate measured. It would doubtless be unfair criticism, to Mr. Staveley's mind, if I did not mention that the distillate should fall in drops from the end of the condenser. There are, however, big drops and little drops, and perhaps the committee which Mr. Staveley and "J. D." propose to consider the process, would stipulate among other things for the diameter of the drop; but, with an open flame, and attending to the "necessary" precautions as nearly as possible, I find I can make the temperature gradually reach 100° C., and only bring off 20 per cent of distillate; or I can arrange the size of the flame so that 50 per cent comes over by the time the temperature reaches 100°, and I will therefore credit Mr. Staveley with being a man of observation when he implies in his last letter that time and kind of apparatus *are* important factors in his method of benzol testing, and I trust he will not consider that I criticise unfairly when I add that *consequently* the process is a stupid one.

Let an absolutely constant source of heat be applied to the retort, and let the height of the barometer be taken into account, and then, and not till then, will the process stand upon a reasonable basis, and then the questions of sizes of condenser and retort, thickness of glass, numbers of drops falling per minute, &c., may be disregarded without seriously interfering with the result. A standard temperature may be obtained by heating the retort with a boiling solution of common salt of a specified density in an apparatus such as that figured in my first letter, taking away the flame used for boiling, the moment the thermometer in the retort indicates 100° C.; or by using the same apparatus as an air-bath, regulating the temperature at, say, 140° C. by an apparatus, which may be bought, and which will keep the temperature constant by regulating the size of the flame which acts as the source of heat. I may add that by distilling benzol with an open flame, taking away the lamp when the temperature rose nearly to 100° C., and applying it again and again as the temperature fell, I got precisely the same result, only with much care and trouble, as that which was obtained by distilling by the heat of a boiling solution of salt with little care or attention.—I am, &c.,

William Thomson.

Manchester, April 30, 1881.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Les Mondes, Revue Hebdomadaire des Sciences.

No. 13, December 9, 1880.

Experiments on the Discharge in Rarefied Gases.—A. Righi.—The cause of the mechanical action peculiar to the negative electrode in a Crookes tube illuminated by a Ruhmkorff coil is the same as in the radiometer. The electric force of the negative electrode acting upon the molecules which depart from it charged negatively, tends to give them a direction normal to the surface of the electrode itself. When these molecules come in collision with the glass they discharge themselves, and the glass becomes luminous. We often see, in fact, discharges passing from the positive electrode to the fluorescent portions of the glass.

No. 14, December 16, 1880.

The Constitution of Benzol.—M. Gerber.—The six carbon atoms of benzol are mutually linked together by nine simple bonds, and the formula which admits three simple and three double bonds must be abandoned as not in harmony with facts.

No. 15, December 23, 1880.

Detection of Starch in Milk.—M. Hager.—The lacto-proteic bodies combine rapidly with free iodine and decolourise the solution. Iodine is therefore added till the milk appears yellow, the mixture is stirred, and after waiting till the yellowness has disappeared more iodine is added till either the yellow colour becomes permanent, or the colouration of iodide of starch makes its appearance

On Spectroscopy.—Dr. L. Ciamician.—The following are the results of the examination of the spectra of certain compounds and of twenty elementary bodies:—Carbon, like other elements, has a spectrum of the first and another of the second order. Cyanogen, carbon oxide, and acetylene are the only carbon compounds having a special peculiar spectrum. The spectra of cyanogen and of carbonyl have a simple relation to those of their components of the first order. The more refrangible side of the spectra of cyanogen and of carbon oxide is homologous to the same side of the spectrum of the first order of carbon, and the less refrangible half of the spectrum of cyanogen is comparable to that of the spectrum of the first order of nitrogen. The spectra of the first order of carbon, boron, silica, and aluminium are mutually homologous. Still, the less refrangible side of the spectra of silicon and aluminium has no corresponding part in those of carbon and boron, and might be compared to the less refrangible region of the spectra of the elements of the oxygen group. Boron, silicon, and aluminium have spectra of the first order corresponding to that of carbon. The spectra of the first and second order of carbon and magnesium are respectively perfectly homologous. The more refrangible part of the homologous spectra of barium, strontium, and calcium is homologous with the spectrum of magnesium. The spectra of oxygen, sulphur, selenium, and tellurium are perfectly homologous among themselves, both in the more and the less refrangible portion. The spectra of phosphorus, arsenic, and antimony are only comparable with those of nitrogen as regards the red portion. The spectra of the halogens and that of fluorine are homologous only as regards their less refrangible portion. The less refrangible part of the spectra of silicon, aluminium, calcium, strontium, and barium is homologous to the same portion of the spectra of the oxygen group. The elements which are best comparable are those placed in a horizontal series in the tables of M. Mendelejeff. These are: Sulphur, silicon, aluminium, calcium, selenium, strontium, tellurium, and barium. The more refrangible parts of the spectra of chlorine, bromine, iodine, phosphorus, arsenic, and antimony are homologues of the more refrangible parts of the spectra of the elements of the oxygen group. The spectra which are best comparable in this respect are those of sulphur, chlorine, phosphorus, selenium, arsenic, tellurium, iodine, and antimony. The relations of homology of the elements as just explained, and the homology of the spectra of cyanogen and carbon oxide with those of their component elements, lead to the supposition that the homology of the spectra of the elements has its ground in their mode of composition. This view, taken in conjunction with the regularities of atomic weights as detected by M. Mendelejeff, gives rise to the following conclusions:—The spectra of carbon, boron, and magnesium, are perfectly homologous among themselves. These three elements are therefore composed of equal matter in different states of condensation, which are manifested by the displacement of the homologous lines. The atomic weights of carbon and boron differ very little; that of magnesium is $24 = 2 \times 12$. The spectra of silicon and carbon are respectively homologous, the more refrangible side corresponding to the spectrum of carbon, and the less refrangible side to that of oxygen. Silicon is therefore a compound of carbon and oxygen conformably to its atomic weight, $28 = 12 + 16$. Aluminium contains carbon under the form of boron (perhaps under that of glucinum), as indicated by its atomic weight, $27 = 11 + 16$, this carbon being combined with oxygen. The metallic elements of the group of alkaline earths produce spectra, the more refrangible part of which corresponds to the spectrum of magnesium, and the less refrangible part to those of the elements of the oxygen series. Consequently, calcium, strontium, and barium are composed of carbon under the form of magnesium and oxygen under the condensation-forms of sulphur, selenium, and tellurium, according to their atomic weights (calcium $= 24 + 16$, strontium $= 24 + 4 \times 16$, barium $= 24 + 7 \times 16$). The elements of the oxygen group are composed of one and the same matter in different states of condensation, manifested by the displacement of the groups of the homologous lines of their spectra. The atomic weights of the elements of this series are:—Oxygen $= 16$, sulphur $= 16 + 1 \times 16$, selenium $= 16 + 4 \times 16$, tellurium $= 16 + 7 \times 16$. The halogens are all composed of fluorine and oxygen in different states of condensation, as shown by their atomic weights:—chlorine $= 19 + 16$, bromine $= 19 + 4 \times 16$, iodine $= 19 + 7 \times 16$. The spectra of the elements of the nitrogen group are homologues, in their less refrangible part of that of nitrogen, and in their more refrangible part of those of the oxygen group. These elements are consequently compounds of nitrogen and of oxygen more or less condensed, as appears from their atomic weights:—Nitrogen $= 14$, phosphorus $= 14 + 16$, arsenic $= 14 + 4 \times 16$, antimony $= 14 + 7 \times 16$.—*Ber. Kaiser. Akademie der Wissenschaft. Wien.*

No. 16, December 30, 1880.

Soap of Molasses.—M. Junemann proposes to manufacture an improved soap by dissolving 28 parts soda-ash in 100 parts molasses, and stirring in 100 parts of oleic acid.

MISCELLANEOUS.

South London School of Pharmacy.—The prizes were awarded to the following successful competitors at the examinations ending the Second (B) Course, and presented on April 30, 1881:—Senior Chemistry, Medal, Mr. Thomas; Junior Chemistry, Medal, Mr. Shaw; Botany, Medal, Mr. Bull; Pharmacy, Medal, Mr. Walker; Materia Medica, Medal, Mr. Kay.

The Native Guano Co.—At the Norwich Fisheries Exhibition a prize of £20 and a silver medal were awarded to the Native Guano Company, Limited, for their success in purifying sewage and other polluted water so as to be innocuous to fish. Some small model tanks were exhibited with fish living in the purified water. The public and the local press seem struck with the necessity of applying this process (A B C process, Sillar's patent) to the treatment of town sewage, which is discharged into fishing-streams.

MEETINGS FOR THE WEEK.

Monday, 9th.—Royal Institution. General Monthly Meeting, 5.
— Royal Geographical, 8.30.
— Society of Arts, 8. "The Art of Lace-Making," Alan S. Cole.
Tuesday, 10th.—Civil Engineers, 8.
— Medical and Chirurgical, 8.30.
— Royal Institution, 3 p.m. "Non-Metallic Elements," Prof. Dewar.
— Society of Arts, 8. "Trade Relations between Great Britain and Her Dependencies," William Westgarth.
Wednesday, 11th.—Society of Arts, 8. "The Manufacture of Glass for Decorative Purposes," H. J. Powell (Whitefriars Glass Works).
— Microscopical, 8.
— Geological, 8.
Thursday, 12th.—Royal, 4.30.
— Royal Institution, 3. "Magnetism," Professor Tyndall.
— Society of Arts, 1. "Recent Progress in the Manufacture and Application of Steel," Professor A. K. Huntington.
— Royal Society Club, 6.30.
— Mathematical, 8.
Friday, 13th.—Royal Institution, 8. "Mental Images and Vision," Mr. F. Galton, 9.
— Society of Arts, 8. "Burmah," General Sir Arthur Phayre, G.C.M.G., K.C.S.I., C.B.
Saturday, 14th.—Royal Institution, 3. "Scotland's Part in English Literature," Prof. Morley.
— Physical, 3.

IRISH HILL BAUXITE (Alum Clay).

The **IRISH HILL MINING CO.** are now, and always have been, the LARGEST PRODUCERS OF THIS CLAY, of Superior Quality, and supply the Manufacturers of Alum, Sulphate of Alumina, and Alum-Cake, of the United Kingdom, America, and the Continent, almost exclusively.

Analysis by John Pattinson, Esq.

Dried at 212° F.

	Gertrude (extra qual.)	1st Quality.	2nd Quality.
Alumina	59·00	53·83	52·00
Peroxide of Iron	0·47	1·57	4·57
Silica	18·00	8·67	12·00
Titanic Acid		5·80	6·20
Lime, Magnesia, Potash, Soda, and Sulphuric Acid	0·23	0·83	1·14
Combined Water	22·30	29·27	24·00
	100·00	99·97	99·91

Our MINES, DRYING KILNS, and GRINDING MILLS are situated very close to the Shipping Ports of BELFAST and LARNE, and adjacent to Railways running alongside both Steamers and Sailing Vessels at both Ports, from either of which shipping is abundant and cheap, therefore we can guarantee Regular Delivery as Buyers require it, and are prepared to quote prices f.o.b. c.i.f., or delivered at any Port, in Bulk or Bags, Lump or Ground.

GEO. G. BLACKWELL, *Managing Director.*

Richmond Buildings, 26, Chapel St.,
Liverpool.

Established 1798.

ROBERT DAGLISH & CO.,

ENGINEERS, BOILER AND BRIDGE MAKERS, MILLWRIGHTS,
BRASS AND IRON FOUNDERS.

Manufacturers of every description of Condensing, or High-pressure Blowing, Pumping, Rolling, Winding, and Patent Steam-engines, of any required power, for Irrigating, Draining, Mining, Rolling Mills, or Water Works purposes, and Manufacturers of every description of Chemical, Colliery, Copper Ore, Gold Mining, Glass, and Rock-salt Machinery.

Black-ash Revolving Furnaces of the Most Approved Type.

Bessemer Steel-Rail Plant.

Compressing-Engines for Collieries, Iron Works, and Weldon's Patent Bleaching-Powder Process.

Caustic, Chlorate, Decomposing, Nitre Nitro-Glycerine, Iodine Potash, Sulphur, Acid, and Oxalic Pans.

Gas Producers Patent for Heating and other Purposes.

Pyrites Burners for Irish, Norwegian, and Spanish Ores of Improved Construction.

Patent Rousing Machinery for Brewers.

Retorts, Acid, Gas, Iodine, Nitric, Nitre Nitro-Glycerine and Vitriol Refining.

Steam Superheaters improved for Oil, Tar, and Resin Refining.

Steam Sulphur Melter.

Stills for Oil, Resin, and Tar.

Wheels, Bevel, Mitre, and Spur Moulded on the Shortest Notice by Patent Machinery.

Makers of Mactear's Patent Carbonating Furnace, Jones and Walsh's Patent Sulphate of Soda Furnace, Parnell and Simpson's Patent Causticiser, and Kynaston's Patent Alum Plan

Lists sent on Application.

Photographs, Plans, and other information supplied on receipt of Order.

ST. HELEN'S ENGINE, BOILER, AND BRIDGE WORKS
AND FOUNDRY,
LANCASHIRE.

These Pumps are especially adapted for MINES, QUARRIES, DYE WORKS, BREWERIES, &c.

They are so simple in construction that repairs can be done by an ordinary mechanic.

BISULPHIDE OF CARBON.

CHLORIDE OF SULPHUR.

GAS PURIFICATION & CHEMICAL CO., LIMITED,
161, 162, 163, Palmerston Buildings, London, E.C

TETRACHLORIDE OF CARBON.
BISULPHIDE OF CARBON.
CHLORIDE OF SULPHUR.

JESSE FISHER & SON,
Phœnix Chemical Works Ironbridge.

THE CHEMICAL NEWS.

Vol. XLIII. No. 1120.

NOTES ON THE OXIDES OF MANGANESE.

By SPENCER UMFREVILLE PICKERING, B.A. Oxon, F.C.S.,
Assistant Master at Highgate School.

(Continued from p. 202.)

§ VI. *Discussion of results.*

The examination of the results recorded in the preceding tables would at first sight lead to the conclusion that the circumstances influencing the behaviour of manganese oxides on being heated remain so far without elucidation. By collecting, however, the substance of these various tables into another single table (VI.), and inserting a column giving the amount of water present in each sample, we bring into prominence a factor which, though it may not entirely determine the results, has at any rate a considerable influence on the behaviour of these oxides. Their behaviour at 100° C., this being the only temperature at which experiments were made in every case, is alone dealt with here.

First of all, it is at once apparent that the amount of the loss or gain of oxygen does not depend entirely on the richness of the oxide experimented on. In the case of the impure oxides, for example (Nos. 1, 2, and 3), the richest specimen absorbs a considerable amount of oxygen, while the poorest, which only contains half the percentage of dioxide, remains absolutely unchanged, and the oxide of intermediate composition absorbs no oxygen, but on the contrary evolves some.* This last-mentioned oxide is also found to undergo nearly the same amount of alteration as one containing double the percentage of dioxide. Taking, again, the pure and dried dioxide (Nos. 4, 5, and 6), we can trace absolutely no relation between the amount of the loss and the oxygen value of the oxide, while with the two pure and undried oxides (Nos. 4 and 8) the amount of the loss varies with the richness of the sample, a small increase in the percentage of dioxide present increasing this loss more than threefold. From these facts it follows that on taking oxides of various composition, and heating them for any length of time at a given temperature between 100° and 200° they will not eventually attain the same composition.

Now on comparing the change effected by heat on the oxides with the amount of water contained in them before heating, we find that, with the first three specimens, the same order attains in both cases, and that when the oxide used is nearly anhydrous no alteration at all takes place. With the next three oxides this does not quite hold good, either No. 5 or No. 6 appearing to be exceptional; but either of these, when taken separately and compared with No. 4, conform to this rule. The last two oxides given in the Table can scarcely be considered in reference to this point, since from the very large amount of water they both contain it is probable that we are dealing with the highest hydrate possible in each case.

The relationship above indicated, although it is the only explanation which can be suggested to explain the results obtained with No. III. as compared with those obtained with No. I.,† is, however, not universal, and might be accidental were it not for the stronger evidence brought forward in favour of this view by the experiments described in the next section.

Table VI.

Showing the Relationship between the Loss or Gain of Oxygen at 100° C. and the Composition of the Oxide.

Oxide.	Ratio of Mn as MnO_2 to Mn as MnO.	Percentage Mn pr'sent as MnO_2. Total Mn present=100.	Percentage of Water present before heating.	Percentage Alteration in the MnO_2 found.
No. 1 (See Table I.)	1·901 : 1	65·53	19·683	1·37 p.c. gain
No. 2 (See Table II.)	0·748 : 1	42·79	3·936	0·665 p.c. loss
No. 3 (See Table III.)	0·494 : 1	33·07	1·050	No alteration.
No. 4 (See Table IV.)	6·014 : 1	85·75	30·113	2·458 p.c. loss
No. 5 (See Table IV.)	6·239 : 1	86·17	21·293	0·682 p.c. loss
No. 6 (See Table IV.)	7·423 : 1	88·13	5·49	1·065 p.c. loss
No. 4 (See Table V.)	6·014 : 1	85·74	95·342	2·657 p.c. loss
No. 8 (See Table V.)	7·270 : 1	87·91	85·422	8·530 p.c. loss

§ VII. *Experiments showing the Alteration Produced by Heating to Depend on the Loss of Water.*

1. *Case in which an Absorption of Oxygen takes place.*—The only one of the above-mentioned oxides which was rendered richer by heating was No. 1, and consequently all the experiments given in the next table refer to this oxide.

The first experiments, made in order to ascertain whether the loss of water influenced the alteration in the oxide, were obviously to heat the oxide in such a manner that all loss of water should be prevented. This was effected in experiments 104 and 105 by actually keeping a weighed portion of the oxide in boiling water for two hours. The mean of the results thus obtained are remarkably concordant with the determinations made before heating at all, and show that no change whatever had taken place during the ebullition. It would, of course, hardly have been expected that any absorption of oxygen could have taken place from a medium containing so little of that gas as boiling water does; but this same circumstance which would prevent the absorption of oxygen by the oxide would have proportionately facilitated the evolution, and if we had found the oxide to become poorer in dioxide by this treatment, we should have concluded it probable that this oxide was a mixture of two oxides, one of which, on being heated at 100° C., absorbed oxygen, while the other at the same time lost oxygen. As it is, however, no such conclusion can be drawn.

The next experiments made on this subject (Experiments 106 to 111 in the Table) consisted in increasing the amount of water evolved by the oxide without raising the temperature, and seeing whether this produced a proportional increase in the absorption of oxygen. In order to effect this, samples of the oxide were heated for some time at 100° in the air-bath as usual, and then moistened and again re-heated, the moistening being repeated at intervals of about half or one hour. The increase in the amount of oxygen absorbed which is produced by this treatment is very remarkable: when moistened and heated twice the gain is more than three times as great as when not moistened at all, and the increase produced goes on augmenting in value with the number of times the oxide is moistened, till in the last experiment, where the moistening had been repeated nineteen times, it amounts to 9·56 per cent, or about 7 times that observed in experiments 9, &c.

In experiments 112 to 115 samples of the oxide in a porcelain boat were placed in a tube passing horizontally

---

* Instead of a loss of 0·665 per cent of the dioxide, perhaps a gain of 0·9 per cent should have been recorded. (See § VIII.)

† The oxide No. 3 was prepared from No. 1 by ignition. (See § III.)

through a large steam-bath. In 112 and 113 a current of the laboratory air was drawn through the tube, and this was nearly saturated with moisture at 14° C., and hence its hygrometric state at 100° C. would be about 1-60th. In the next two experiments the air was carefully dried, and this fact of the air being dry, and therefore capable of abstracting a great amount of moisture from the oxide, caused the increase in dioxide found to be raised from 1·35 to 6·75 per cent. The amount of water lost in each case was approximately determined, and is given in the table. In every case the heating was continued until the oxide became constant in composition.

The experiments Nos. 112 to 115 in this Table, as well as Nos. 73 to 77 in Table IV., and Nos. 116 to 122 in Table VIII., were performed more recently than the others, and in them the temperature of 100° C. was accurately attained by the use of a steam-bath; and on comparing the results of Nos. 112 and 113 with the similar ones in Table I. (Nos. 9 to 14) we find that the increase recorded is nearly identical, which fact would lead us to conclude that the temperatures observed in the earlier experiments with an air-bath express the truth with considerable accuracy.

TABLE VII.

Experiments showing the Absorption of Oxygen to depend on the Loss of Water.

Oxide No. 1 used.

Conditions of Experiment.	Percentage of MnO_2 found, calculated on the unheated Oxide.		Percentage Increase in the MnO_2 present.
Before heating—			
1. (See Table I.)..	55·396		
After heating—			
9. At 100° C. in an air-bath (See Table I.)	56·152		1·37
104. After being kept in boiling water for 2 hours	55·297	55·393	none
105. Ditto ditto	55·489		
Heated at 100° C.—			
106. For 1½ hrs., during which moistened twice	57·773		4·29
107. For 5½ hrs., ditto, 4 times	58·454		5·52
108. For 6½ hrs., ditto, 5 „	58·797		6·14
109. For 6½ hrs., ditto, 6 „	59·672	59·689	7·75
110. For 6½ hrs., ditto, 6 „	59·706		
111. For 21½ hrs., ditto, 19 „	60·692		9·56
Heated at 100° C.—			
112. In a steam-bath in moist air. Lost 11·02 p.c. Aq	56·246	56·157	1·35
113. Ditto, ditto 10·78 „	56·068		
114. Do., dry air 12·80 „	59·016	52·203	6·75
115. Ditto, ditto 13·70 „	59·390		

2. *Cases in which an Evolution of Oxygen occurs.*—The oxide which was selected for these experiments was unfortunately one of the pure oxides which underwent least change on being heated, and hence the differences observed in the various cases are not so marked as they might have been had one of the other specimens been used.

The first experiments on the subject were made by boiling weighed quantities of the oxide in water for various lengths of time (Experiments 116 to 118, Table VIII). Contrary to what had been expected, a change is effected by this treatment, which change is complete in two-and-a-half hours, but not in an hour-and-a-half. The loss in oxygen under these circumstances is, indeed, greater than when the oxide is heated in air. Hence it appears that any hindrance to the loss of oxygen which may be made by preventing a loss of water has been more than counterbalanced by the facilities offered for this loss by the presence of a boiling liquid, as indicated above. These experiments, therefore, afford us no evidence in favour of our theory, but, on the contrary, show that even when (probably) no loss takes place* an evolution of oxygen may still be made to occur. The next experiments, however, prove satisfactorily that the loss of water is an important factor in determining the loss of oxygen. They consist, like some of the experiments in the previous table, of heating the oxide at 100° C. in moist and in dry air; and we find that here, as on the former occasions, the use of dry air increases the amount of change, the loss being nearly twice as great as when moist air is used.

TABLE VIII.

Experiments showing the Evolution of Oxygen to depend on the Loss of Water.

Oxide No. 5 used.

Conditions of Experiment.	Percentage of MnO_2 found, calculated on the unheated Oxide.		Percentage Diminution in the MnO_2 found.
Before heating—			
73. (See Table IV.)	69·618		
After heating—			
75. At 100° in air (Table IV.)	69·143		0·682
Kept in boiling water—			
116. For 1½ hours..	69·804		
117. For 2½ hours..	68·639	68·750	1·247
118. For 4 hours..	68·862		
Before heating—			
73. (See Table IV.)	69·618		
After heating at 100° in a steam-bath in moist air—			
119. For 1½ hours..	69·407		
75. For 2½ hours..	69·053	69·143	0·682
76. For 3½ hours..	69·204		
77. For 4 hours..	69·131		
In dry air at 100° C.—			
120. For 1½ hours..	69·558		
121. For 2 hours..	68·815	68·798	1·178
122. For 3 hours..	68·780		

(To be continued.)

DYEING REDS WITH ARTIFICIAL ALIZARIN.

By M. MAURICE PRUD'HOMME.

SINCE several years, the methods of madder dyeing have undergone a complete revolution, the origin of which we will seek to point out. When artificial alizarin, thanks to the beautiful researches of Graebe and Liebermann, made its industrial appearance in 1869, it was soon found that the commercial product, though yielding beautiful purples, was incapable of producing brilliant reds (C. Kœchlin). Whilst admitting that the new product was identical with the alizarin extracted from madder, we were led to conclude that in order to produce fine Turkey reds, the colouring matters which accompany alizarin must play an important part. This was the idea propounded by Kuhlmann as far back as 1828 (*Soc. Ind. de Mulhouse*, 49, p. 86). According to the researches of MM. Schützenberger and Schiffert, the colouring matters of madder are alizarin, purpurin, pseudopurpurpurin, purpuroxanthin, and an orange matter, which M. Rosenstiehl considers identical with hydrated purpurin. Subsequently, there have been added to the list an orange body, purpuroxantho-carbonic acid of Schunck and Roemer, identical with the munjistin found by Stenhouse in the madder of India. It was known that purpuroxanthin does not dye; that pseudopurpurin is very easily transformed into purpurin, and the uncertainty which was felt concerning hydrated purpurin left room

---

* Even, here, however, a loss of water may have occurred. It is not at all contrary to general experience that a highly hydrated substance which has been prepared in the cold should become partially dehydrated at 100° C., even though immersed in water.

merely for the hypothesis that Turkey-red is obtained by the concurrent action of alizarin and purpurin. In the meantime, the manufacture of artificial alizarin became extended, and a compound was sold as "alizarin for reds." It is now known, thanks to the researches of Perkin, Schunck, Roemer, Graebe, and Liebermann, that in the manufacture of artificial alizarin there are produced three distinct colouring matters—alizarin, iso- or anthra-purpurin, and flavopurpurin, the two latter being isomers of purpurin. We may remark that purpurin has not been obtained by direct synthesis. M. de Lalande has produced it by the oxidation of alizarin. Alizarin is derived from mono-sulph-anthra-quinonic acid, on melting with the hydrate of potassa or soda. It is a dioxy-anthraquinone.

Anthra-purpurin and flavo-purpurin are obtained from two isomeric disulph-anthraquinonic acids, improperly named iso-anthraflavic and anthraflavic acids, which are converted into anthrapurpurin and flavopurpurin by a more profound action of potassa. These two bodies are trioxy-anthraquinones.

We call to mind that alizarin dyes reds of a violet tone, free from yellow; roses with a blue cast and beautiful purples. Anthrapurpurin and flavopurpurin differ little from each other, though the shades dyed with the latter are more yellow. The reds produced with these colouring matters have a very bright yellowish reflection, but the roses are too yellow and the purples incline to a dull grey.

Experience with the madder colours shows that a mixture of alizarin and purpurin yields the most beautiful roses in the steam style, but it is not the same in dyeing, where the roses got with fleur de garance have never been equalled. A mixture of alizarin and of anthra- or flavo-purpurin is not a perfect substitute for alizarin and purpurin. In practice the three sulph-anthraquinonic acids, the generators of the three colouring matters, are easily separated by varying the concentration and the quantity of the sulphuric acid employed, and by taking advantage of the different solubility of the salts of each.

"Alizarins for reds" all contain more or less of alizarin properly so-called, from 1 to 10 per cent, along with anthrapurpurin and flavopurpurin. This proportion does not affect the tone of the reds obtained further than by preventing them by having too yellow a tone.

The first use of the alizarins for reds was for application of styles, that is colours containing at once the mordant and the colouring matter and fixed upon the cloth by the action of steam. Good steam-reds were easily obtained by using receipts originally designed for extracts of madder (mixtures of alizarin and purpurin). On the other hand, the first attempts at dyeing red grounds and red pieces were not successful. The custom of dyeing up to a brown with fleur and then lightening the shade by a succession of soapings and cleanings had much to do with this failure. Goods, mordanted with alumina and dyed with alizarin for reds up to saturation, never reach the brown tone given by fleur or garancin. This tone is due in great part to the presence of fawn-coloured matters, which the cleanings and soapings served to destroy or remove. The same operations have also another end—to transform the purpurin into its hydrate, which is brighter and more solid. The shade, in a word, loses in depth and gains in brightness. With alizarins for reds, the case is quite different; they contain no impurities to remove and no bodies which may gain brightness in consequence of chemical changes under the influence of the clearings and soapings. These have only one result, in addition to the formation of a lake of fatty acid, that is to make the shades lose in intensity. The method of subjecting reds got up with alizarin to the same treatment as madder-reds was faulty.

There appeared next a method of dyeing bases upon different principles. The work of M. Schützenberger (1864) speaks of the use of sulpho-conjugated fatty acids for the fixation of aniline colours. In England, for a number of years, dyed-reds had been padded in soap-baths and afterwards steamed to brighten the red. In 1867, Braun and Cordier, of Rouen, exhibited Turkey reds dyed in five days. The pieces were passed through aluminate of soda at 18° B., then through ammonium chloride, washed, dyed with garancin, taken through an oil-bath dried and steamed for an hour, and were finally cleared in the ordinary manner for Turkey-reds. The oil-bath was prepared by treating olive-oil with nitric acid. This preparation, invented by Hirn, was applied since 1846 by Braun (Braun and Cordier). Since 1849, Gros, Roman, and Marozeau, of Wesserling, printed fine furniture styles by block upon pieces previously taken through sulpholeic acid. When the pieces were steamed and washed the reds and roses were superior to the old dyed reds and roses produced at the cost of many sourings and soapings. Certain makers of aniline colours sold mixtures ready prepared for printing which were known to contain sulpholeic acids. There was thus an idea in the air that sulpholeic acid, under the influence of steam, formed brilliant and solid lakes with colouring matters. These facts detract in nothing from the merit of M. Horace Kœchlin, who combined these scattered data into a true discovery. The original process may be summed up under the following heads:—Printing or padding with an aluminous mordant, which is fixed and cleaned in the usual manner; dyeing in alizarin for reds with addition of calcium acetate; padding in sulpholeic acid and drying; steaming and soaping. The process was next introduced into England, whence it returned with the following modifications: in place of olive-oil or oleic acid, castor oil was used, as cheaper, and the number of operations was reduced. Castor oil, modified by sulphuric acid, can be introduced at once into the dye-beck, so that the fixation of the colouring matter as the lake of a fatty acid is effected in a single operation. The dyeing was then followed by steaming and soaping.

For red on white grounds and for red grounds, a mordant of red liquor at 5° to 6° B. is printed on, with a little salt of tin or nitro-muriate of tin. It is fixed by oxidation at 30° to 35° C., and dunged with cow-dung and chalk. The pieces are then dyed with 1 part alizarin for reds at 10 per cent, $\frac{1}{4}$ to $\frac{1}{2}$ oil for reds (containing 50 per cent), 1-6th part acetate of lime at 15° B., giving an hour at 70° and half an hour at the same heat. Wash, pad in oil (50 to 100 grms. per litre of water), dry on the drum, or better in the hot flue, and steam for three-quarters to an hour and a half. The padding in oil is needless, if sufficient oil has been used in dyeing, and the pieces may be at once dried and steamed. Wash and soap for three-quarters of an hour at 60°. Give a second soaping if necessary. If there is no fear of soiling the whites, dye at a boil for the last half-hour, which is in part equal to steaming.

Red pieces and yarns may be dyed by the process just given for red grounds; or, prepare in neutral red oil, in the proportion of 150 grms. per litre of water for pieces and 15 kilos. for 100 kilos. of yarns. For pieces, pad with an ordinary machine with rollers covered with calico. Dry the pieces in the drum, and the yarn in the stove. Steam three-quarters of an hour at 1$\frac{1}{2}$ atmosphere. Mordant in pyrolignite of alumina at 10° B., and wash thoroughly. Dye for an hour at 70° and half an hour longer at the same heat, using for 100 kilos. of cloth or yarn 20 kilos. alizarin at 10 per cent, 10 kilos acetate of lime at 18° B., and 5 kilos. sulpholeic acid. Steam for an hour. Soap for a longer or shorter time, with or without the addition of soda crystals. There may be added to the aluminous mordant a little salt of tin to raise the tone. Lastly, aluminate of soda may be used as a mordant in place of red liquor or sulphate of alumina.

Certain firms employ a so-called continuous process. The pieces are passed into a cistern 6 metres long and fitted with rollers. This dye-bath contains from 3 to 5 grms. of alizarin per litre of water and is heated to 98°. The pieces take 5 minutes to traverse this cistern and, owing to the high temperature and the concentration of the dye liquor, they come out perfectly dyed. Two pieces may even be passed through at once, one above the other. As the dye-bath becomes exhausted, it must be recruited from time to time with fresh quantities of alizarin. The great advantage of this method is that it economises not merely time but colouring matter.

The quantity of acetate of lime to be employed in dyeing varies with the composition of the mordant and with that of the water. Schlumberger has shown that Turkey-red contains 4 molecules of alumina to 3 of lime. Rosenstiehl has shown that alumina mordants are properly saturated if two equivalents of lime are used for each equivalent of alizarin, if the dyeing is done without oil. These figures require to be modified when the oil is put into the dye-beck, as it precipitates the lime. Acetate of lime at 15° B., obtained by saturating acetic acid with chalk and adding a slight excess of acetic acid, contains about ¼ mol. acetate of lime.—*Bulletin de la Société Chimique de Paris.*

ON M. C. FAURE'S SECONDARY BATTERY.

The researches of M. Gaston Planté on the polarisation of voltameters led to his invention of the secondary cell, composed of two strips of lead immersed in acidulated water. These cells accumulate and, so to speak, store up the electricity passed into them from some outside generator. When the two electrodes are connected with any source of electricity the surfaces of the two strips of lead undergo certain modifications. Thus, the positive pole retains oxygen and becomes covered with a thin coating of peroxide of lead, while the negative pole becomes reduced to a clean metallic state.

Now, if the secondary cell is separated from the primary one, we have a veritable voltaic battery, for the symmetry of the poles is upset, and one is ready to give up oxygen and the other eager to receive it. When the poles are connected, an intense electric current is obtained, but it is of short duration. Such a cell, having half a square metre of surface, can store up enough electricity to keep a platinum wire 1 millim. in diameter and 8 centims. long, red-hot for ten minutes. M. Planté has succeeded in increasing the duration of the current by alternately charging and discharging the cell, so as alternately to form layers of reduced metal and peroxide of lead on the surface of the strip. It was seen that this cell would afford an excellent means for the conveyance of electricity from place to place, the great drawback, however, being that the storing capacity was not sufficient as compared with the weight and size of the cell. This difficulty has now been overcome by M. Faure: the cell as he has improved it is made in the following manner:—

The two strips of lead are separately covered with minium or some other insoluble oxide of lead, then covered with an envelope of felt, firmly attached by rivets of lead. These two electrodes are then placed near each other in water acidulated with sulphuric acid, as in the Planté cell. The cell is then attached to a battery so as to allow a current of electricity to pass through it, and the minium is thereby reduced to metallic spongy lead on the negative pole, and oxidised to peroxide of lead on the positive pole; when the cell is discharged the reduced lead becomes oxidised, and the peroxide of lead is reduced until the cell becomes inert.

The improvement consists, as will be seen, in substituting for strips of lead masses of spongy lead; for, in the Planté cell, the action is restricted to the surface, while in Faure's modification the action is almost unlimited. A battery composed of Faure's cells, and weighing 150 lbs., is capable of storing up a quantity of electricity equivalent to one horse-power during one hour, and calculations based on facts in thermal chemistry show that this weight could be greatly decreased. A battery of 24 cells, each weighing 14 lbs., will keep a strip of platinum ⅝ths of an inch wide, 1-32nd of an inch thick, and 9 ft. 10 ins. long, red-hot for a long time.

The loss resulting from the charging and discharging of this battery is not great: for example, if a certain quantity of energy is expended in charging the cells, 80 per cent of that energy can be reproduced by the electricity resulting from the discharge of the cells; moreover, the battery can be carried from one place to another without injury. A battery was lately charged in Paris, then taken to Brussels, where it was used the next day without re-charging. The cost is also said to be very low. A quantity of electricity equal to one-horse power during an hour can be produced, stored, and delivered at any distance within 3 miles of the works for 1½d. Therefore these batteries may become useful in producing the electric light in private houses. A 1250 horse-power engine, working dynamo-machines giving a continuous current, will in one hour produce 1000 horse-power of effective electricity, that is to say 80 per cent of the initial force. The cost of the machines, establishment, and construction will not be more than £40,000, and the quantity of coal burnt will be 2 lbs. per hour per effective horse-power, which will cost (say) ½d. The apparatus necessary to store up the force of 1000 horses for twenty-four hours will cost £48,000, and will weigh 1500 tons. This price and these weights may become much less after a time. The expense for wages and repairs will be less than ¼d. per hour per horse-power, which would be £24 a day, or £8800 a year; thus the total cost of one horse-power for an hour stored up at the works is ¾d. Allowing that the carriage will cost as much as the production and storing, we have what is stated above, viz., that the total cost within 3 miles of the works is 1½d. per horse-power per hour. This quantity of electricity will produce a light, according to the amount of division, equivalent to from 5 to 30 gas burners, which is much cheaper than gas.

CHLORO-BROMIDE OF LEAD.

By MALVERN W. ILES.

In the treatment of the Leadville carbonate ores by the blast-furnace, the writer has noticed a number of very curious and interesting compounds. The facilities here offered for an extended observation are unusually good, inasmuch as the Grant Smelting Co. works have a capacity for treating no less than 150 to 200 tons of ore per day, and an opportunity is offered for collecting furnace products from seven different furnaces.

A compound having the formula $Pb(BrCl)$ has recently been discovered, occurring as a furnace product, in small (2½ inch) circular openings, in the cast-iron supporting plate 11½ inches above the water-jacket. The iron ring rests upon four cast-iron columns, and supports the sheet-iron fire-brick lined structure above. This ring-plate is perforated by holes, which serves to prevent a total rupture of the plate by the expansion caused by the internal heat.

The courses of fire-brick at the boshes close these holes from below, whilst the interior fire-brick lining covers these circular openings, thus forming a small condensation chamber in which the chloro-bromide of lead was found.

As neither Dana nor Naumann makes mention of this compound, and we have been unable to find any description given in any work at our disposal, we feel justified in stating such physical and chemical observations as we have noticed in our investigation.

In order to see whether this compound was contaminated with any silver salt, it was assayed, 1-10th assay ton yielding by cupellation only a most minute trace. Hence it is to be concluded that this was simply an accidental occurrence of a small amount of ore, or a trace of a volatile silver salt.

We have recently noticed that the white fumes that condense upon the surrounding cool objects in the vicinity of the slag tap-hole yield 3½ ounces of silver per ton; hence it is not improbable that there is some volatile compound of silver not clearly identified, and which slightly mingles with the chloro-bromide of lead.

Properties.

The furnace crystals occurred in several forms, as, for example, in pure white, delicate, dendritic plates, not unlike crystals of lead chloride; in long acicular needles, in semi-fused distorted needles having a slightly yellowish tint, and also in entirely fused warty masses.

It dissolves in warm water, forming a milky white turbidity, which readily clears up on the addition of a few drops of nitric acid. The aqueous solution deposits plate-like crystals, and from the moderately dilute solution, by slow crystallisations, one may obtain doubly terminated acicular needles, considerably thickened in the central portion.

It sublimes on charcoal, giving a white coating. In a closed tube it melts readily to a bright red colour; upon cooling it lightens up, changing from a lemon-yellow to a pure white. On increasing the heat it sublimes in heavy oily drops. Density 5·741.

This product is found to be very stable, and is decomposed by boiling concentrated sulphuric acid, only by repeated applications, and the complete transformation into a sulphate is difficult.

Analyses.

Chlorine + Bromine.

				Per cent (Br+Cl).
0·559 grm. salt gave	0·573	grm.	$(AgBr+AgCl)$ =	35·714
1·251 ,, ,,	1·2825	,,	,,	35·718
1·251 ,, ,,	1·277	,,	,,	35·566
Average of three determinations.. ..				35·666

Lead.

0·559 grm. salt gave 0·513 grm. $PbSO_4$ = 62·695 p. ct. Pb.
1·086 ,, ,, 0·996 ,, ,, 62·717 ,, ,,
1·251 ,, ,, 1·167 ,, ,, 63·729 ,, ,,

The first and second determinations were made upon the furnace product, while the substance used for the last determination was the result of purification by crystallisation from an aqueous solution.

Bromine.

1 grm. fused $(AgCl+AgBr)$ gave a loss on passing dry pure chlorine gas over the salt, in a bulb tube, of 0·141 grm. = 0·595055 grm. AgBr = 25·321 per cent Br.

The formula $Pb(BrCl)$ requires Pb = 64·186 per cent and $(Br+Cl)$ = 35·814 per cent. We may state our results as follows:—

Found.		Calculated.	
Pb	63·729 per cent.	Pb	64·186 per cent.
Br	25·321 ,,	Br Cl	35·814 ,,
Cl	10·345 ,,		
	99·395		100·00

The mixed silver salt was readily prepared by making an aqueous solution (aided by a few drops of nitric acid), and adding silver nitrate; after purification, by washing with hot water, the salt was dried and analysed. 0·570 grm. $(AgCl+AgBr)$ was mixed with pure granulated lead and cupelled in the assay muffle, of course after scorification, and the usual precautions taken for rich chloride ores. The weight of the silver button was 0·36345 grm., which corresponds to 63·763 per cent silver; theoretical percentage for formula = 65·158 per cent.

A chloro-bromide of silver, or embolite, has been described and analysed by Prof. Th. Richter,[*] which closely corresponds to the above compound, termed *megabromite* by Breithaupt.

Prof. Richter's analyses gave Ag = 64·19 per cent, Br = 26·49 per cent, Cl = 9·32 per cent. The ratio of the bromine to the chlorine 1 : 0·8, whilst we found in the compound under consideration a ratio of 1 : 0·92.

Inasmuch as the furnaces from which the chloro-bromide of lead was collected had been in blast for some time, it is reasonable to conclude that the chloro-bromide of silver existing in these ores has the same general composition as shown in the above haloid silver salt. While we do not deny the probability that the chloro-bromide of lead may have existed in the ores as such, yet it can readily be seen how a decomposition may have taken place in such a manner as to produce this lead salt, since it is a well-known fact that heated metallic lead will decompose all known salts of silver. In conclusion we may state that samples of this compound have been forwarded to Profs. Richter, Dana, Remsen, Chandler, and others.—*American Chemical Journal.*

Chemical Laboratory, Grant Smelting Co.,
Leadville, Colorado.

---

[*] Berg- und hüttenmännische Zeitung, 18, 449.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, May 5, 1881.

Prof. H. E. Roscoe, President, in the Chair.

The following certificates were read for the first time:—G. H. Bostock, W. Bedford, J. M. Collett, A. E. Davies, J. E. Doyle, C. W. Marsh, A. Philip.

During the evening a ballot was held, and the following gentlemen were declared by the Scrutators (Dr. Hugo Müller and Prof. McLeod) to be duly elected Fellows of the Society:—A. J. Anderson, F. J. O. Farroll, T. R. Ord, G. E. Robinson, A. J. Shilton, W. R. Smith, F. P. Venable, G. H. With.

The following papers were read:—

"*On the Action of Humic Acid on Atmospheric Nitrogen,*" by E. W. Prevost. The author has repeated the three following experiments of E. Simon (*Land. Vers. Stats.*, xviii.):—(1) Humic acid and water were sealed up in a tube containing nitrogen; (2) nitrogen was passed for twelve hours through a Liebig's potash bulb containing water and humic acid; (3) humic acid and water were placed in an ordinary flask, whose mouth was closed by a caoutchouc stopper. In all these experiments Simon states that perceptible quantities of ammonia were formed. The author was unable to confirm this statement: in only one case was any formation of ammonia observed. In this experiment 3 grms. of humic acid were hermetically sealed in a glass tube with 20 c.c. of water and 76·6 c.c. of air, and exposed to the light for eighteen months; at the end of that time the water contained ammonia equal to 0·19 c.c. of nitrogen. The author used two samples of humic acid, one purchased from Hopkin and Williams, the other prepared by himself from peat: the humic acid was not soluble in water.

Dr. Gilbert said that he was disposed to agree with the conclusions of Dr. Prevost that there was at present no proof of absorption of nitrogen from the air by ordinary soils. With cereal crops 20 lbs. of nitrogen could be taken out of a soil per acre, and then a distinct decrease in the nitrogen in the soil could be noticed by analysis; but in the case of the Leguminosæ the case was not so clear. For instance, 200 lbs. of nitrogen could be removed per acre with a clover crop, and yet not only was there no decrease in the nitrogen in the soil, but in the surface soil an increase could be proved, after the removal of the crop. Where this increase came from has not been satisfactorily settled. One theory was that it came from the nitrogen in the air; another, that the wide-spreading clover roots abstracted the nitrogen from a considerable depth of soil, and from the falling leaves, &c., the nitrogen in the surface soil increased. It must also be considered that there was some difficulty in getting a fair sample of the soil, and that the quantity of combined nitrogen in an acre of ordinary soil 4 ft. 6 ins. deep was enormous (about 10,000 lbs.) as compared to the above quantities. Again, although clover crops are to a certain extent indifferent to nitrogen, they do not get on in a soil where there is no nitrogen.

"*On the Active and Inactive Amylamines, corresponding to the Active and Inactive Alcohols of Fermentation*," by R. T. Plimpton. The author has studied these bodies in order to see whether any differences similar to those which distinguish active from inactive amyl alcohol can be detected in their corresponding derivatives. The inactive amylamines were obtained by heating the mixed alcohols with gaseous hydrochloric acid (*Comptes Rendus*, lxxvii., 1021), which first attacks the inactive alcohol: a quantity of inactive amyl chloride was thus procured. The chloride was heated with its own volume of saturated alcoholic solution of ammonia, and the resulting hydrochlorides distilled with potash. The amylamines so obtained were separated by fractionation, &c. Monamylamine (boiling-point, 96° to 97°) had no action on polarised light. Diamylamine (boiling-point 185° to 186°); the hydrochloride is insoluble in ether. Triamylamine (boiling-point 237°); the hydrochloride is soluble in ether. In each case the platinochloride, aurochloride, and the hydrochloride were prepared and examined. Active amylamines:—About 3 litres of the mixed alcohols were distilled in a current of hydrochloric acid for five weeks, until the quantity was reduced to 760° grms. in a 10 c.m. tube; rotation=4°. The monamylamine was obtained partly by converting the alcohol into cyanate and cyanurate of amyl and boiling with potash, and partly by heating the bromide to 100° with alcoholic ammonia. A length of 10 c.m. rotated 3° 5′ to 3° 30′ to the left; boiling-point 96° to 97°; its hydrochloride is deliquescent, and its solution rotates feebly to the right. The diamylamine was obtained by heating the active amyl bromide to 130° with its own weight of alcoholic ammonia (boiling.point 182° to 184°); 10 c.m. rotated 5° 15′ to the right; the hydrochloride is easily soluble in water, alcohol, and ether; it is optically more active than the free amine. The triamylamine was obtained by heating the active diamylamine with amyl bromide (boiling-point 230° to 237°; 10 c.m. rotated 44° 15′ to the right. The auro and platino-chlorides were prepared. The salts of the active amylamines differ from their inactive isomers in being deliquescent and difficult to crystallise; they are also more soluble. The inactive salts, on the other hand, crystallise well; the boiling-points and specific gravities also differ slightly. A Cornu polariscope was used, and the rotation is given for the yellow ray.

"*On the Action of Sodium Alcoholates on Fumaric Ethers*," by T. Purdie. Wislicenus long since investigated the action of the alkali metals on ethyl fumarate: sodium had no action at ordinary temperatures, but potassium acted vigorously, producing, however, such a complicated reaction as to offer but little prospect of elucidation. More recently, by the action of sodium ethylate in alcoholic solution, and subsequent addition of methyl iodide, a dibasic acid was obtained, which had the formula $C_6H_{10}O_5$. The author has undertaken this research to determine the constitution and mode of formation of this acid. The fumaric acid was prepared in the usual manner from malic acid. The ethylic ether was prepared in three different ways:—By leading hydrochloric acid gas into a mixture of alcohol and acid: by heating the acid with sulphuric acid and alcohol; by the action of silver fumarate on ethyl-iodide. The first method is attended with certain disadvantages. The action of sodium ethylate and methyl iodide on ethyl fumarate was conducted according to the well-known method used at Würzburg in the preparation of the organic disubstituted aceto-acetic ethers. At first two molecules of methyl iodide were used to two atoms of sodium and one molecule of ethyl-fumarate; finally half the quantity of sodium and methyl iodide was used in order to secure a better yield. The mixture was heated for twenty minutes, when it had a neutral reaction. On the addition of water an oil separated, boiling at 225°; it proved to be the acid $C_6H_{10}O_5$; it was converted into a lead salt, which was decomposed by sulphuretted hydrogen. The pure acid crystallised *in vacuo*, melted at 86°. When ethyl iodide was substituted for methyl iodide in the above reaction the same acid was obtained. Finally, the action of sodium ethylate alone on ethyl-fumarate was studied; the same acid was produced. Subsequent investigation confirmed the view that it was an ethyl-ether malic acid,—

$$\left\{\begin{array}{l}CH(OC_2H_5)COOH\\CH_2COOH\end{array}\right.,$$

isomeric with Desmondesir's monethyl malate. The author has studied its properties, and formed its calcium, barium, and silver salts. The action of sodium isobutylate on isobutyl-fumarate was investigated in a similar way; isobutyl malic acid,—

$$\left\{\begin{array}{l}CH(OC_4H_9)COOH\\CH_2COOH\end{array}\right.,$$

was obtained, and its salts studied. When sodium ethylate free from alcohol is added to ethyl-fumarate an addition-product is apparently formed, from which, possibly, by the addition of alcohol iodide, the synthesis of homologous acids might be effected. The author promises further research on this subject.

"*On the Products of the Action of Alkalies on Ethylic β-ethyl-aceto-succinate*," by L. T. Thorne. By the action of strong potash, an ethyl-succinic acid was obtained identical with that prepared from α-ethyl-aceto-succinic ether. When, however, weak (5 per cent) potash solution was used α-ethyl-β-aceto-propionic acid was formed, which on attempted distillation gave off water, a new substance, $C_7H_{10}O_2$, being at the same time formed. This substance is a colourless oily liquid, with neutral reaction and pleasant smell, boiling at 219°, vapour-density 5·014. The author hopes to be able to resume the investigation and settle the constitution of this substance, which he therefore leaves unnamed.

"*On some Carbazol Compounds*," by E. H. Rennie and W. R. Hodgkinson. The authors have studied the action of potassium carbazol (obtained by dropping potassium into melted carbazol) on ethyl-chloro-carbonate; white crystals were obtained having the formula,—

$$(C_6H_4)_2NCOOC_2H_5.$$

The substance may be looked upon as a new urethane.

The Society then adjourned to May 19, when the following papers will be read:—"On the Reaction between Hydrogen and Nitric Oxide in the Presence of Spongy Platinum," by Lewis T. Wright; "A Method for the ready Estimation of a Soluble Sulphide and Free Sulphurous or Free Sulphuric Acid, even in the Presence of Sulphates," by O. V. Pisani.

ROYAL INSTITUTION OF GREAT BRITAIN.

Annual Meeting, Monday, May 2, 1881.

William Bowman, LL.D., F.R.S., in the Chair.

The Annual Report of the Committee of Visitors for the year 1880, testifying to the continued prosperity and efficient management of the Institution, was read and adopted. The Real and Funded Property now amounts to above £85,400, entirely derived from the Contributions and Donations of the Members.

Forty-nine new Members paid their admission fees in 1879.

Sixty-two Lectures and Nineteen Friday Evening Discourses were delivered in 1880.

The books and pamphlets presented in 1879 amounted to about 166 volumes, making with 555 volumes (including periodicals bound) purchased by the Managers, a total of 721 volumes added to the library in the year.

Thanks were voted to the President, Treasurer, and Secretary, to the Committees of Managers and Visitors, and to the Professors, for their valuable services to the Institution during the past year.

The following gentlemen were unanimously elected as officers for the ensuing year.

President—The Duke of Northumberland, D.C.L., LL.D.
Treasurer—George Busk, Esq., F.R.C.S., F.R.S.
Secretary—Warren De La Rue, Esq., M.A., D.C.L., F.R.S., Cor. Mem. Inst. France, &c.

General Monthly Meeting, Monday, May 9, 1881.

George Busk, Esq., F.R.S., Treasurer and Vice-President, in the Chair.

The following Vice-Presidents for the ensuing year were announced:—William Bowman, F.R.S.; Frederick Joseph Bramwell, F.R.S.; Sir W. Frederick Pollock, Bart., M.A.; William Spottiswoode, D.C.L., F.R.S., Pres. R.S.; George Busk, F.R.S., Treasurer; Warren De La Rue, M.A., D.C.L., F.R.S., Secretary. Frederick Arthur Crisp, Ernest Gye, and Samuel Armstrong Lane, F.R.C.S., were elected Members.

John Tyndall, D.C.L., LL.D., F.R.S., was re-elected Professor of Natural Philosophy.

PHILOSOPHICAL SOCIETY OF GLASGOW.

CHEMICAL SECTION.

Monday, April 4, 1881.

Mr. R. R. Tatlock, F.I.C., F.R.S.E., in the Chair.

Mr. C. Hope, of St. Rollox Chemical Works, read a paper on "*Analysis of Soaps.*" He said:—

In this paper to the Section I intend giving, for the full analysis of soda soaps, a method which I have used for some considerable time, and which I find to be useful in giving information as to how the soap has been made, and also as giving an exact analysis of it, which is much desired by some consumers, and not usually done by analysts. In some cases a much shorter analysis will suffice, but in a soap works laboratory the full one will be very often wanted. Before weighing off portions of the soaps I think it is absolutely necessary to cut off the outer skin and take the inside, otherwise discrepancies will result not otherwise to be accounted for. The skin is a very small portion, usually of the bar or cake, and it would be a difficult operation to get the proper amount of skin in the different portions weighed.

Water.—The first thing to be done is to cut some thin shavings of the sample, weighing about 5 grms., and place them in a small, tared, flat porcelain basin, and the exact weight noted. It is then put in the water-bath, and heated until it ceases to lose weight; a night generally suffices for this purpose. When that is done it is weighed in the morning, and a number of small holes made with a pin in the dried slices, and put in the bath again for a few hours and re-weighed. If there is no further loss, as is generally the case, it is certain the soap is thoroughly dry. Some chemists have condemned this method of estimating the water, because they say it fails to give off the last 1 or 2 per cent; but I find that such is not the case, because when a soap is dried as I have described, it will give no further loss even if heated to its decomposing point.

Fatty Acids.—A portion of the soap, weighing about 5 grms. in the form of miniature bars, is introduced into a separating funnel of about 120 c.c. capacity, and about 50 c.c. of water at, say, 100° F. poured in, then enough acetic acid to decompose the soap and leave a small excess, and finally about 50 c.c. of ordinary ether. The stopper is then put in the funnel, and the whole shaken until the soap is all dissolved. It is then allowed to settle for a few minutes, when the fatty acids will be found to have dissolved in the ether, and floating on the watery solution which contains the soda salts, &c. The bottom stopper is then opened slightly, and the watery solution of the salts allowed to *drop* slowly out until it stops, then the top stopper is taken out, and the remainder of the water allowed to drop slowly out until only a few drops remain, at which time the stopper is shut. The funnel is then filled up with water about 90° or 100° F., the stopper replaced and shaken for a minute or so, allowed to settle, and the same operation as before repeated. The washing is continued until the washings are neutral, at which point the last few drops are allowed to go out, taking care not to allow any of the etherial solution to follow it. It is always necessary to open the bottom stopper first, as there is enough ether vapour in the funnel to cause an outward pressure, which on opening the top stopper first causes a few small drops of the ether solution to splutter out, a proceeding not to be desired, and which is effectually prevented by operating as described. The dropping of the washings is to be carefully done, otherwise the washings will be found to have a skin of fatty acids floating on the surface, which of course would cause a low result, and therefore must be carefully guarded against. The etherial solution of the fatty acids is then poured out by the top of the funnel into a previously-tared beaker of about 150 c.c. capacity, and the funnel rinsed out with fresh ether. The beaker is then covered with filter paper and placed on the top of the water-bath until the ether is evaporated. If the odour still remains in the beaker a few minutes inside the bath remove it completely. If the water has not been completely removed from the funnel, a few small drops of water will be seen in the fatty acids and may be removed by the addition of a few drops of absolute alcohol, and then heated inside the water-bath until its odour is gone. The beaker is now cooled and weighed, and when the tare is deducted gives the weight of fatty acids in the quantity of soap taken.

Total Alkali.—For this determination I take 31 grms. of the soap, and put it into a 500 c.c. flask, and dissolve with the aid of heat in hot water. 50 c.c. of standard sulphuric acid are then added, and the flask filled up to the mark; 100 c.c. are filtered off, put into a beaker, and titrated with standard pure caustic soda, using litmus as an indicator. The acid used is a normal one, 1 c.c. = 0·062 grm. Na_2O, and the soda is one-tenth of that strength, 1 c.c. = 0·0062 grm. Na_2O.

Sodic Chloride.—To the above neutralised solution some solution of yellow chromate of potash is added, and then titrated with a decinormal solution of silver, 1 c.c. = 0·00585 grm. NaCl.

Free Alkali.—3·1 grms. of the sample in thin shavings are weighed off and dissolved in rectified alcohol, then filtered as rapidly as possible, and the insoluble matter washed with boiling alcohol. A few drops of alcoholic solution of phenol thalein are added to the filtrate, and then titrated with the decinormal acid. This gives the free alkali existing as hydrate, usually only a trace or none.

Soda existing as Silicate and Carbonate.—The part insoluble in alcohol is dissolved on the filter with hot water, carbonic acid passed into the filtrate to precipitate a trace of lime usually in it, then thoroughly well boiled, and filtered. The filtrate is then titrated with the decinormal acid, using litmus as indicator.

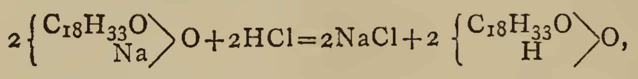
Soda existing as Carbonate.—5 grms. of the soap are dissolved in rectified alcohol, washed as before, and the insoluble dissolved in water. The solution containing the carbonate and silicate is put into a flask fitted with a set of two U-tubes containing solution of baric hydrate, and decomposed with dilute acid, and the CO_2 boiled out into the U-tubes. The baric carbonate is filtered off as quickly as possible, the excess of hydrate washed from it, and the precipitate titrated with standard decinormal acid.

Sulphate of Soda.—10 grms. of the soap are dissolved in water decomposed with HCl, and the fatty acids filtered off. The filtrate is precipitated with $BaCl_2$, and finished in the usual manner.

Silica.—25 or 50 grms. are ignited in a platinum basin, and the residue treated with HCl, evaporated to dryness, retreated with HCl, and the insoluble silica filtered off, ignited, and weighed.

Lime, Iron, &c.—The filtrate from the silica is made alkaline with ammonia, some oxalate of ammonia added, the precipitate collected, ignited, and weighed.

Calculation and Statement of Results.— The water, silica, lime, &c., and sodic chloride are simply calculated to per cent. The barium sulphate is calculated to per cent of sodic sulphate. The alkali soluble in alcohol is calculated to NaHO, and the acid used for titrating the baric carbonate to sodic carbonate. The "soda existing as carbonate" is deducted from the "soda existing as silicate and carbonate," and the difference stated as "soda existing as silicate." The silica cannot be stated as silicate of soda because the "silicate" as used and as it exists in the soaps is not a normal one. It has an approximate composition of Na_2O2SiO_2, but it is evidently not a definite compound, so that under those circumstances it is necessary to state the silica as such, and give the soda existing with it. It was pointed out by a writer in the Chemical News some years ago, and seems to be still ignored, that although in the process of analysis the fat is separated and weighed as fatty acid, it exists in the soap as fatty anhydride, as the following reaction representing the decomposition of sodic oleate by an acid shows:—



$$2\left\{\begin{matrix}C_{18}H_{33}O \\ Na\end{matrix}\right\rangle O + 2HCl = 2NaCl + 2\left\{\begin{matrix}C_{18}H_{33}O \\ H\end{matrix}\right\rangle O,$$

and that by multiplying the fatty acids by the factor 97, the true weight of fatty matter existing in the soap was found. If the fatty acids are stated in the analysis it will be found that the analysis will total to nearly 102; therefore, because the per cent. of fatty acids are usually wanted, I generally report the analysis in the following manner:—

	Per cent.
* Fatty anhydride	
Soda existing as soap	
Water	
Sodic carbonate	
,, hydrate	
,, chloride	
,, sulphate	
Silica	
Soda existing as silicate	
Lime, &c.	———

* = Per cent fatty acids
Per cent total soda.

There are two other important points in connection with soap analysis, viz., the determination of the resin, and the melting-point of the fatty acids, that I intended to speak of in this paper, but I have not been able to get the experiments finished, so that I must leave them for a future communication to the Section. A method for the accurate determination of resin in soap, whether easy of execution or otherwise, is a thing still wanted. I have been working lately at a method which, although not a quick one, promised well for accuracy, and which I now find to give results short of the truth, because of the different resinic acids in rosin having different solubilities in certain reagents.

The Secretary, Dr. Dobbie, read a paper by Mr. R. Thomson, Mr. E. B. Clark, and himself "*On the Occurrence and Composition of Eugenite and other Rare Minerals.*" In this paper the authors described the conditions under which the minerals were found, and gave a short account of the methods employed by them in separating the rare elements contained in the minerals from one another.

Dr. Dobbie read a short paper "*On the Conversion of Dolomitic Limestone into Serpentine.*"

The Chairman intimated that this meeting was the last for the present session, and congratulated the Section on the success which had attended their meetings throughout the past winter.

CORRESPONDENCE.

THE SO-CALLED "BUNSEN PUMP."

To the Editor of the Chemical News.

Sir,—Prof. Roscoe, President of the Chemical Society of London, in enumerating the works of his friend Prof. Bunsen, says, in *Nature* of the 28th ult. ("Scientific Worthies," p. 600):—"To him we are also indebted for the apparatus for accelerating filtration, the "Bunsen pump," together with all its appliances, now employed in every laboratory."

This assertion requires correction. The pump used by Prof. Bunsen for accelerating filtration was invented by me, and not by Prof. Bunsen, as would appear from the use of his name in connection with it. I described the construction of the *water* air-pump distinctly and plainly in the *Journal of the Chemical Society of London* for January, 1865, under the title "Researches on the Vacuum: I. The Instruments" (not the instrument, as some will read) and I sent a copy of this paper to Prof. Bunsen, inscribed with a suitable allusion to our former relationship as pupil and teacher, during the spring of 1865. Three years later Prof. Bunsen published his paper "On the Washing of Precipitates," in which he describes again my pump, *but unfortunately omitted to quote my paper of* 1865.

The following is a translation of Prof. Bunsen's own words:—

"To create the difference of pressure for filtration, one cannot employ any of the air-pumps commonly used, especially not the mercury air-pump, as the liquids to be filtered contain not unfrequently chlorine, sulphurous acid, sulphuretted hydrogen, and other substances, which would destroy the metallic portions of the apparatus. I therefore employ a water air-pump constructed of glass on the principle of Sprengel's mercury air-pump, which for all chemical purposes is, as I believe, preferable to every other apparatus for air-rarefaction, where it suffices to push the rarefaction no further than to a pressure of mercury from 6 to 12 millimetres."—(*Ann. Chem. Pharm.*, 1868, vol. 148, p. 277.)

The peculiar stress laid here on the uselessness of mercury air-pumps, and on the fact that chlorine attacks mercury, combined with the omission of all reference to my paper, where both *water and glass* are mentioned, gave to Prof. Bunsen's description of the instrument a colour of originality, which Prof. Roscoe (and with him many others) think right to support and to perpetuate by calling it the "Bunsen pump."

As this misnomer has been already the subject of a disclaimer from Prof. Bunsen (Chemical News, vol. xxvii., p. 49, 1873) of remonstrances both from myself (*Ibid.*), from Prof. Frankland (*Nature*, 1876, vol. 14, p. 74), and from others, I am sorry to see that Prof. Roscoe should continue to use this designation, which is intended to honour an "*employer*" of the instrument, which hurts the feelings of its inventor and deprives him of his only reward—the satisfaction of being credited with having placed a useful servant at the disposal of Science and Industry.

If any other inventor less eminent than Prof. Bunsen had made the omission, which I have pointed out with much reluctance, no one would persist in giving his name to my child; nor (reversing the case) would anybody speak of a pump as "Sprengel's pump," if I had received from Prof. Bunsen the paper of 1865, and said in 1868, "I therefore employ a water air-pump constructed of glass on the principle of Bunsen's mercury air-pump." This misnomer is the result of a reprehensible hero-worship. Hero-worship is all very well, and quite harmless, provided it is cultivated with a due regard to other people's property—otherwise it ceases to be so. For this reason I think it a duty to myself, as well as to other inventors, that I should record on this occasion my courteous protest against this unwarranted disposal of my property by the President of the Chemical Society of London.—I am, &c.,

H. Sprengel.

London, Savile Club, May 7, 1881.

THE SOCIETY OF CHEMICAL INDUSTRY.

To the Editor of the Chemical News.

Sir,—"Caustic Alkali" (Chemical News, vol. xliii., p. 194) is too flattering. I do not suppose that my views would have greatly influenced his committee, even if made known earlier, and still less that they can damp the prospects of the Society now that it is fairly launched. I may say, however, that I did not gather from what went before the last meeting, at which I was unfortunately unable to be present, that the Society was so ripe for constitution. My remarks are rather to be taken as a heavy groan, whereby I relieved my own mind. I am, however, gratified to find that "Caustic Alkali" endorses my view that the new Society might have been affiliated to the Chemical Society. I should be glad to know why such a proposal was not made at a general meeting of the Fellows of the Chemical Society.

Something of the divided feeling which I deplore to see between chemists, is to be observed in "Caustic Alkali's" reference to the Institute. I think our profession is altogether too young to bear the strain of much division. It seems to me, also, that, instead of quietly waiting until, by the "long result of time," we slowly *grow* into importance, there is too much tendency to be constantly posing before the public as being already a very important body. It is a part of the unhealthy haste of the present day.

As a technical chemist, connected for nearly twelve years with a very large concern, in connection with which I have succeeded in establishing important improvements, I shall be only too glad if the new Society can break down some of the barriers to the advancement of technical chemistry. But I must still regret that in doing so, it should be thought necessary to further tax our profession in time and money, when, by slightly extending existing organisations, the same end might have been reached at less expense, and unity among chemists promoted at the same time.—I am, &c.,

F.I.C., F.C.S.

THE ALLEGED IDENTITY OF THE RED COLOURING-MATTER OF WINES AND OF THE BILBERRY.

To the Editor of the Chemical News.

Sir,—It has lately been stated repeatedly that the red colouring matters of wine and of the bilberry are identical. These statements are, however, it seems to me, based on insufficient grounds; for, however closely these colouring-matters may resemble each other, the red colouring-matter found in genuine red wines is certainly not *identical* with the red colouring-matter of the bilberry.

To show this it is only necessary to make use of the simple test described by the writer in 1876 (*Analyst*, Nos. 2 and 11), namely, submitting the colouring-matter to dialysis. In a paper published in the *Journ. Chem. Soc.*, August, 1880, the statement will be found that the colouring-matter of bilberries *dialyses*, whereas it had previously been shown the red colouring-matter of pure wines *does not dialyse*.

The spectroscope is undoubtedly, in practised hands, an admirable means for the detection of certain colouring-matters which may have been added to a wine. For the discovery, however, of the broad fact, whether or no a foreign colouring-matter has been added to a wine, the spectroscope is nothing like so certain in its application as the gelatine cube, and even for the detection of the special colouring-matter employed it is in but few cases of greater use.—I am, &c.,

A. Dupré.

Laboratory, Westminster Hospital,
London, S.W., May 7, 1881.

PITCH-HOUSE EXPLOSIONS IN TAR DISTILLERIES.

To the Editor of the Chemical News.

Sir,—With regard to the letter of your correspondent "Hydrocarbon," I may just say that when connected with the tar distilling industry, two cases of explosion of the kind mentioned by your correspondent came under my direct notice. The theory of spontaneous ignition I cannot, however, see my way to accept, and the temperature of the melted pitch, though high, is not high enough to fire a mixture of air and such hydrocarbon vapours. There is one prolific source of danger of explosion, however, in cases of this kind, which I will mention, and I believe it to be the almost invariable cause. This is the presence of fire, red-hot embers, red-hot iron, or other surfaces, &c., in the immediate neighbourhood of the tar still-tap, or of the inlet by which the highly heated and molten pitch runs to the covered gutter or main leading it to the pitch house. The presence of fire or red-hot substances in such a place is easily explained. When a tar still is to be run off, and this is generally late at night or very early in the morning to avoid nuisance, the large tap is often found to be blocked up and immovable with pitch of a former running off. The still man therefore usually takes a shovelful of fire from a still furnace and applies this to the tap in order to melt the adherent pitch, and, seeing this accomplished, the man *sometimes* at once lays down the shovel *with the embers still upon it*, and applies the tap-key, turns the tap, and, forgetting his shovel, turns away to avoid the smoke of the pitch. If the shovel be pretty near this inlet, and the wind in its direction (and there will certainly be a slight draught or current down the covered gutter or main caused by the motion of the swiftly flowing pitch), a flame may pass down the gutter under given conditions of admixture with air, and fire the contents of the pitch house, causing an explosion. The danger mentioned is still greater when, as in some large works, two stills are run off soon after one another, and firing the tap has to be resorted to in the case of the second still. Here the pitch house is thoroughly charged with inflammable vapours from the pitch of the still first run in, so that on firing the tap of the second still, even the approximation of the fire (and some embers might easily be dropped), may be sufficient to fire the gaseous mixture in the still-smoking main. Sometimes this running-off process has to be performed in the dark, and a *lantern* is used, and perhaps carelessly. Or, again, the hour for this process being as mentioned either a late or very early one, the man, though knowing the practice to be a prohibited one, taking advantage of the foreman's absence, may be going to work with a lighted pipe in his mouth. Davy lamps it is true are used in some distilleries, but the men, like the colliers, often strive to evade the use of them, because of the feeble light afforded. If the distillation had been carried very far, the pitch being in part almost coked, its temperature on running off must be very high, in order to remain fluid; in fact, fresh from the still tap any organic matter, such, for example, as a piece of paper, would be charred on coming in contact with it, and I could even imagine the possibility of its smouldering or even taking fire under certain exceptionally favourable conditions. Of course, also, in the case of a still under such circumstances, the danger of firing the tap incautiously will have reached a maximum.—I am, &c.,

Watson Smith, F.C.S., F.I.C.

The Owens College, Manchester.

METHOD OF TESTING THE VALUE OF INSOLUBLE PHOSPHATES.

To the Editor of the Chemical News.

Sir,—Prof. Robert Galloway in his letter to the Chemical News, vol. xliii., p. 209, condemns the citrate of ammonia process for estimating retrograde phosphates, because there is no citric acid present in the soil to carry out the process of dissolving on a large scale. I fail to see the relevancy of his proposition. Agricultural chemists agree pretty well that even phosphates soluble in water retrograde in the soil when coming into contact with lime, oxide of iron and alumina, and that plants assimilate the phosphates to a very large extent in this retrograde state, probably with the assistance of a series of organic acids in the soil. Of course, in artificial manures, soluble phosphates are to the farmer far more valuable than insoluble or even retrograde phosphates. The former being for a certain time kept in solution, distribute through soil or sub-soil to far greater an extent than could possibly be accomplished by any other means of mechanical subdivision. The analytical chemist is thus entitled to base his method of estimation upon the action of a chemical reagent, such as citrate of ammonia, on the retrograde phosphates, without distinction whether the latter has been formed in the factory, the store house, or in the soil, as long as he places phosphates soluble in water upon a higher commercial standard.—I am, &c.,

Julius Ostersetzer.

Dublin, May 9, 1881.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, l'Académie des Sciences. No. 13, March 28, 1881.

Formation-Heat of Diallyl, of the Chlorated Bodies, and of Aldehyd.—MM. Berthelot and Ogier.—On comparing the formation-heats of diallyl and dipropargyl it is seen that formations effected according to like equations do not necessarily give rise to the same thermic phenomena in the series of the carbides of hydrogen any more than among elementary bodies. The substitution of chlorine for hydrogen in organic compounds gives rise to considerable thermic effects, which diminish with the number of equivalents substituted, and which vary with the series and the chemical function.

Remarkable Case of Globe-Lightning and of Diffused Lightning near the Surface of the Ground.—A. Trécul.—On August 25, 1880, the author saw in full daylight a very brilliant yellowish white body issue from a dark cloud. It had a well-defined outline and seemed to re-enter the cloud, but left behind it a small portion of its substance, which fell perpendicularly, like a heavy body, leaving behind it a luminous train, bordered with sparks, or reddish globules. During its fall it became divided, but without the production of any sound. The diffused light has been often observed during electric storms, and probably belongs to the same class as the fire of St. Elmo.

Attempt to Apply the Principle of Carnot to Electro-chemical Action.—G. Chaperon.—A mathematical paper, not suitable for abstraction.

Construction of Photophonic Selenium Receivers.—E. Mercadier.—These receivers are made by taking two slips of brass 1-10th m.m. in thickness, 0·01 m. wide, and from 1 to 5 metres in length. They are separated by two slips of parchment paper of about 0·15 m.m. in thickness. The whole is rolled up in a coil as tight as possible, and kept together by means of two pieces of wood held by two screws. The two surfaces are polished with the file. The apparatus is then heated in the sand-bath to the temperature at which selenium begins to melt. A stick of selenium is drawn along its surface, and the layer receives the characteristic slate colour indicated by Bell. These receivers are continuous and have the same properties as the ordinary discontinuous receivers, plane or cylindric.

Disturbing Causes which Affect Telephonic Transmission.—A. Gaiffe.—It is probable that the vibrations caused by the wind act upon the wire lines like shocks. The author thinks that to avoid such perturbations it will be necessary to cause the telephones to speak by means of electric action sufficiently powerful that the currents produced in the line itself may not be appreciable.

Preparation and Properties of Chromous Chloride and Sulphate.—H. Moissan.—The author has prepared chromous chloride by the action at red heat of a current of dry hydrochloric acid upon melted chromium prepared by the process of M. Deville, or by the action of ammonium hydrochlorate upon chromium sesquichloride. The sesquichloride is heated to redness in a tube of Bohemian glass, and the vapours of the hydrochlorate are passed over it.

Phospho-platinic Compounds.—E. Pomey.—The author has attempted to form $P(C_2H_4Cl)_3PtCl_2$ by the action of phosphorus perchloride upon the phosphoplatinous ether of Schützenberger, but without success.

Products of the Action of Ammonium Hydrochlorate upon Glycerin.—A. Etard.—The result of the reaction is a liquid alkaloid, $C_6H_{10}N_2$, which the author names glycolin.

Verhandlungen des Vereins zur Beförderung des Gewerbfleisses. Part 7, 1880.

Appreciation of Patents Granted in Germany.—VII. Class 8, Bleaching, Dyeing, Tissue-Painting, and Finishing.—Dr. H. Grothe.—The reproduction of this paper is specially interdicted, as is very frequently the case with memoirs of general interest. It may strike the reader as singular that such a subject was not entrusted to a colourist rather than to an engineer, who has naturally given his main attention to the machinery employed in the above-named arts.

Part 8, 1880.

Experiments on the Spontaneous Ignition of Coal.—H. Hædicke.—The reproduction of this memoir is formally prohibited.

Part 10, 1880.

This number contains no chemical matter.

Reimann's Färber Zeitung, No. 6, 1881.

A tolerably correct account is given of Nesbitt's patent process for preventing tampering with cheques. The writer assumes, however, that no one would use "so fugitive a colour as litmus for such a purpose," and that the paper is "probably coloured blue with ultramarine," which is a complete mistake.

M. Salzmann and F. Krüger patent a process for the preparation of red, violet, and green dyes by the action of chloropicrin upon the aromatic amines. Aniline and its homologues, in the state of free bases, or as salts, and with or without an addition of metallic chlorides, is heated for a length of time to 100° to 210°, along with chloropicrin. There are produced red dyes soluble in water, and violets soluble in alcohol, which can be converted into sulphacids.

No. 7, 1881.

According to a correspondent from Mulhouse, the new aniline oil for producing ungreenable aniline-blacks is not very successful. Impure aniline-oils have always given a black less liable to turn green.

A process is said to have been discovered for printing alizarin steam-reds upon unoiled calico. A new steam indigo-blue and a process for fixing aniline ponceau upon cotton are spoken of, but the particulars have not transpired.

No. 8, 1881.

This number contains nothing of general interest.

MISCELLANEOUS.

Society of Arts: Cantor Lectures.—The fifth and concluding course of Cantor Lectures for the present Session, at the Society of Arts, will be by Mr. R. Brudenell Carter, on the subject of "Colour Blindness, and its Influence on Various Industries." The course consists of three lectures, the first of which will be delivered upon Monday next, the 16th inst. This lecture will deal generally with the subject. The second lecture will treat of methods of testing for colour blindness, the prevalence of the affection, mistakes of the colour blind, and methods of endeavouring to counteract the defect. The subject of the third lecture is specially the industries chiefly affected by colour blindness. In it an account will be given of recent legislation on the subject in America, and the necessity for it in this country.

MEETINGS FOR THE WEEK.

Saturday, 14th.—Physical, 3. "Electric Absorption in Crystals," Prof. H. A. Rowland and E. H. Nichols. "An Absolute Line Galvanometer," Prof. G. M. Minchin. "The Ascent of Hollow Glass Bulbs in Liquids," Dr. E. J. Mills, F.R.S.

Monday, 16th.—Society of Arts, 8. "Colour Blindness, and its Influence upon Various Industries," R. Brudenell Carter, F.R.C.S.

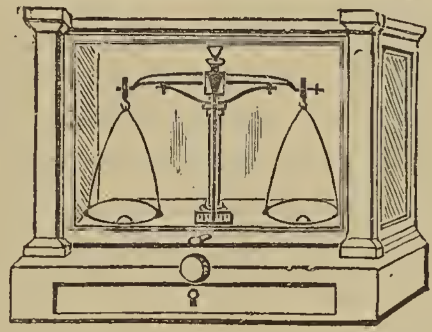
Tuesday, 17th.—Civil Engineers, 8.
— Royal Institution, 3 p.m. "Non-Metallic Elements," Prof. Dewar.

Wednesday, 18th.—Society of Arts, 8. "The Electrical Railway, and the Transmission of Power by Electricity," Alexander Siemens.
— Meteorological, 7.
— Pharmaceutical (Anniversary), 11.

Thursday, 19th.—Royal Institution, 3. "Magnetism," Professor Tyndall.
— Royal, 4.30.
— Philosophical Club, 6.30.
— Chemical, 8. "On the Reaction between Hydrogen and Nitric Oxide in the Presence of Spongy Platinum," Lewis T. Wright. "A Method for the Ready Estimation of a Soluble Sulphide and Free Sulphuric Acid, Even in the Presence of Sulphates," O. V. Pisani.

Friday, 20th.—Royal Institution, 8. "Shakspeare Criticism," Mr. W. H. Pollock, 9.

Saturday, 21st.—Royal Institution, 3. "Russian Literature: Pouschkin," Prof. C. E. Turner.



IRISH HILL BAUXITE (Alum Clay).

The **IRISH HILL MINING CO.** are now, and always have been, the LARGEST PRODUCERS OF THIS CLAY, of Superior Quality, and supply the Manufacturers of Alum, Sulphate of Alumina, and Alum-Cake, of the United Kingdom, America, and the Continent, almost exclusively.

Analysis by John Pattinson, Esq.

	Dried at 212° F.		
	Gertrude (extra qual.)	1st Quality.	2nd Quality.
Alumina	59·00	53·83	52·00
Peroxide of Iron	0·47	1·57	4·57
Silica	18·00	8·67	12·00
Titanic Acid		5·80	6·20
Lime, Magnesia, Potash, Soda, and Sulphuric Acid	0·23	0·83	1·14
Combined Water	22·30	29·27	24·00
	100·00	99·97	99·91

Our MINES, DRYING KILNS, and GRINDING MILLS are situated very close to the Shipping Ports of BELFAST and LARNE, and adjacent to Railways running alongside both Steamers and Sailing Vessels at both Ports, from either of which shipping is abundant and cheap, therefore we can guarantee Regular Delivery as Buyers require it, and are prepared to quote prices f.o.b. c.i.f., or delivered at any Port, in Bulk or Bags, Lump or Ground.

GEO. G. BLACKWELL, *Managing Director.*

Richmond Buildings, 26, Chapel St.,
Liverpool.

Established 1798.

ROBERT DAGLISH & CO.,

ENGINEERS, BOILER AND BRIDGE MAKERS, MILLWRIGHTS,

BRASS AND IRON FOUNDERS.

Manufacturers of every description of Condensing, or High-pressure Blowing, Pumping, Rolling, Winding, and Patent Steam-engines, of any required power, for Irrigating, Draining, Mining, Rolling Mills, or Water Works purposes, and Manufacturers of every description of Chemical, Colliery, Copper Ore, Gold Mining, Glass, and Rock-salt Machinery.

Black-ash Revolving Furnaces of the Most Approved Type.

Bessemer Steel-Rail Plant.

Compressing-Engines for Collieries, Iron Works, and Weldon's Patent Bleaching-Powder Process.

Caustic, Chlorate, Decomposing, Nitre Nitro-Glycerine, Iodine Potash, Sulphur, Acid, and Oxalic Pans.

Gas Producers Patent for Heating and other Purposes.

Pyrites Burners for Irish, Norwegian, and Spanish Ores of Improved Construction.

Patent Rousing Machinery for Brewers.

Retorts, Acid, Gas, Iodine, Nitric, Nitre Nitro-Glycerine and Vitriol Refining.

Steam Superheaters improved for Oil, Tar, and Resin Refining.

Steam Sulphur Melter.

Stills for Oil, Resin, and Tar.

Wheels, Bevel, Mitre, and Spur Moulded on the Shortest Notice by Patent Machinery.

Makers of Mactear's Patent Carbonating Furnace, Jones and Walsh's Patent Sulphate of Soda Furnace, Parnell and Simpson's Patent Causticiser, and Kynaston's Patent Alum Plan

Lists sent on Application.

Photographs, Plans, and other information supplied on receipt of Order.

ST HELEN'S ENGINE, BOILER, AND BRIDGE WORKS AND FOUNDRY,
LANCASHIRE.

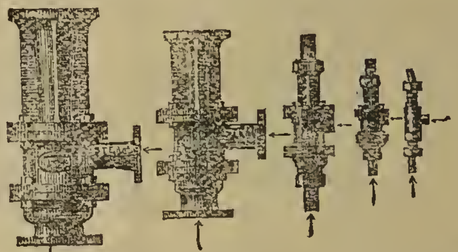
BAILEY'S

LOW LIFT STEAM JET PUMPS,

(HALLAM'S PATENT)

For Lifting Water from Wells, Steam Ships, Tanks, Rivers, Reservoirs, &c.

The three smaller ones are all Gun Metal.



Cast Iron with Gun metal Fittings.

Prices for Heights of not more than 40 ft., at 30 lbs. Pressure.

Please note these when ordering,	6	5	4	3	2	1	0	0A
Bore of Water Delivery Pipe in inches	4	3	2	1½	1	¾	½	½
Bore of Steam Pipe	2½	1½	1¼	1	¾	½	⅜	¼
Delivery in gals. per hour at 30 lbs. prssre.	8000	5000	2500	1500	800	500	200	100
Price .. £	20 0	12½	10 0	7 10	4 10	3 3	2 2	1 10

W. H. BAILEY and CO., Engineers, &c.,
ALBION WORKS, SALFORD, MANCHESTER.

Water-Glass, or Soluble Silicates of Soda and Potash, in large or small quantities, and either solid or in solution, at ROBERT RUMNEY'S Ardwick Chemical Works Manchester.

Wanted, to Purchase Volumes 1, 2, 3, 4, and 5 of the "Journal of Society of Telegraph Engineers."—Address, A. E. A., Chemical News Office, Boy Court, Ludgate Hill, London, E.C.

THE CHEMICAL NEWS.

Vol. XLIII. No. 1121.

NOTES ON THE OXIDES OF MANGANESE.

By SPENCER UMFREVILLE PICKERING, B.A. Oxon, F.C.S.,
Assistant Master at Highgate School.

(Concluded from p. 214.)

§ VIII. *Molecular Alteration gradually taking place in these Oxides.*

The curious facts to be described in this paragraph throw new and great difficulties in the way of any investigation on the oxides of manganese and at the same time detract considerably from the value of the above results.

Some time after the experiments on the oxide No. 4, Table IV., were made, I found occasion to repeat some of these experiments, and was considerably surprised on observing that, instead of a loss of oxygen being effected by heating, a decided absorption took place, and that this absorption, as in the case of No. 1, was augmented by raising the temperature. On examining three other of the oxides (Nos. 6, 8, and 2) a similar change was found to have taken place; they all now gained oxygen on being heated, although when first prepared they had most decidedly lost some under similar circumstances. These experiments are given below in Table IX., together with the results obtained soon after the preparation of the oxides.

It will here be seen that the least time in which this alteration in behaviour of an oxide was observed is in the case of No. 8, where only fourteen days had elapsed between the two sets of experiments. This case, however, is the only one out of the four given on which little or no reliance can be placed, since the evidence of the final absorption of oxygen depends here on a single experiment. This is particularly unfortunate, since the change observed in this case is greater than in any other, in addition to which this specimen was an exceptional one, it having been kept in the moist condition throughout the time of change. In the other three cases the oxides, though hydrated, were mechanically dry and had been kept in bottles with greased stoppers, so that no loss or gain of moisture could have occurred; that such a gain or loss, however, had not occurred was proved in each case by a separate analysis. In the case of No. 2 the date of its preparation was unfortunately unknown. The experiments with it, however, would lead us to conclude that the first investigation of it was not made long after its preparation, and they also render it probable that the opposite was the case with No. 1, and that this oxide also, if it had been examined at an earlier date, would have lost and not absorbed oxygen.

All these experiments, therefore, prove conclusively that hydrated oxides of manganese undergo a gradual molecular change, which entirely alters their behaviour when heated.

§ IX. *Ignition of Oxides.*

In performing the analyses of the above oxides the method of operating necessitated the ignition of the substance so as to expel the water present (see § II.). In order to ascertain the weight of the ignited oxide quickly, and therefore more accurately, three weighings were generally made, the last of which showed as a rule that a constant weight had been obtained before the second one; and in operating in this way it was found that the oxide thus formed was remarkably constant in composition,

Table IX.

Experiments illustrating the Alteration Produced by Time.

Oxide.	Date of Experiments since the preparation of the Oxide.	Conditions of Experiment.	Percentage of MnO_2 found, calculated on the unheated Oxide.		Percentage Alteration in the MnO_2 found.
84. No. 4	Same day	Before heating	4·102	(See Table V.)	
87. ,,	,,	After heating at 100° C. ..	3·993	,, ,,	2·657 loss
67. ,,	20 days	Before heating	61·545	(See Table IV.)	
70. ,,	,,	After heating at 100° C. ..	60 032	,, ,,	2·458 loss
123. ,,	58 days	Before heating	61·632	61·538	
124. ,,	,,	,, ,, ...	61·301		
125. ,,	,,	,, ,, ...	61·511		
126. ,,	,,	After heating at 100° C. ..	62·892	63·086	2·498 gain
127. ,,	,,	,, ,, ,, ..	63·253		
128. ,,	,,	,, ,, ,, ..	63·213		
78. No. 6	2 days	Before heating	85·149	(See Table IV.)	
80. ,,	,,	After heating at 100° C. ..	84·242	,, ,,	1·065 loss
82. ,,	,,	,, ,, 200° C. ..	83·621	,, ,,	1·795 loss
129. ,,	80 days	Before heating	85·001	85·140	
130. ,,	,,	,, ,, ...	85·280		
131. ,,	,,	After heating at 100° C. ..	85·306	85·344	0·24 gain
132. ,,	,,	,, ,, ,, ..	85·382		
133. ,,	,,	,, ,, 165° C. ..	85·603	85·737	0·701 gain
134. ,,	,,	,, ,, ,, ..	85·871		
135. ,,	,,	,, ,, 190° C. ..	85·973	86·088	1·114 gain
136. ,,	,,	,, ,, ,, ..	86·203		
98. No. 8	4 days	Before heating	13·107	(See Table V.)	
101. ,,	,,	After heating at 100° C. ..	11·989	,, ,,	8·53 loss
137. ,,	18 days	,, ,, ,, ..	13·596		3·73 gain
35. No. 2	*x* days	Before heating	45·993	(See Table II.)	
37. ,,	,,	After heating at 100° C. ..	45·687	,, ,,	0·665 loss
39. ,,	,,	,, ,, 183° C. ..	45·526	,, ,,	1·015 loss
138. ,,	*x*+487 days	Before heating	45·899		
139. ,,	,, ,,	After heating at 100° C. ..	46·407		0·900 gain
140. ,,	,, ,,	,, ,, 195° C. ..	47·589		3·47 gain

although no attempt was made in order that it should be so. From 0·2 to 0·5 grm. of substance (after ignition) was used in each analysis, and the ignition was performed in a thin platinum dish over an ordinary Bunsen's burner. The percentages of manganese found in these ignited oxides in the various analyses are given below:—

Gas at Day Pressure.		Gas at Night Pressure.	
141.	69·958	153.	71·758
142.	69·827	154.	71·650
143.	69·849	155.	71·010
144.	69·717	156.	73·061
145.	69·688	157.	71·040
146.	69·903	158.	70·353
147.	69·751	159.	74·997
148.	69·693	160.	72·003
149.	69·790	161.	72·488
150.	69·831	162.	71·277
151.	69·926	163.	70·416
152.	69·901		
Mean ..	69·8195	Mean ..	71·823

The numbers in the first column were obtained when the gas was turned on at the day pressure, and the percentages formed in this case show an extreme variation of 0·27 per cent, all the results indicating that the oxides had been reduced somewhat beyond Mn_2O_3, which contains 69·592 per cent of manganese. With the gas at the right pressure the results obtained were not nearly so regular, the mean of the eleven numbers given here being 71·823, among which Nos. 156, 159, and 161 show that the oxides may in this way be reduced further than Mn_3O_4, which requires 72·03 per cent of manganese, probably owing to the permeability of heated platinum to reducing gases as indicated above.

§ X. *Comparison of the above Results with the Work of other Chemists.*

My original statement made in a paper above alluded to (*Journ. Chem. Soc.*, 1879, 659) that these oxides of manganese lost oxygen on being heated at 100° or 250°, was in direct opposition to the experience of Wright and Luff on the subject, for they had found that no material loss of oxygen took place at 200°. Their actual determinations, however, scarcely warranted such a conclusion, for the numbers given by them show that with one oxide a loss of as much as 2·6 per cent of the total available oxygen present had been effected by the heating; the other specimen examined by them experienced no loss of oxygen at 200° in air, nor at 250° C. in a vacuum produced by a Sprengel pump.* In a subsequent publication (*Jour. Chem. Soc.*, 1880, 25) Wright and Menke contradict these results and confirm my statement that a loss of oxygen does take place at 210° C. Of two samples prepared from potassium permanganate and nitric acid containing potash as an impurity, the first lost 2·95 per cent of its total available oxygen, and the second lost 2·90 per cent. A specimen prepared by the ignition of the nitrate of manganese, lost no oxygen at 210° C., although being much richer in oxygen than the first two, it might have been expected to lose more than they did; the explanation, however, of its not doing so lies, no doubt, in the fact that it contained only 1·14 per cent of water, whereas the others contained 5·27 and 11·56 per cent respectively. None of these oxides suffered any appreciable loss of oxygen at 100° C.

Veley (*Journ. Chem. Soc.*, 1880, 581), experimenting on two samples of pure manganese oxide, in which—

$$\frac{\text{Mn as MnO}_2}{\text{Mn as MnO}} = 5,$$

and which after dryings at 30° to 40° C. contained 10·61 per cent of water, found an absorption of oxygen to take place, beginning at 130° to 140° C. and ending at 160 C.; this absorption increased the available oxygen present by as much as 10 per cent of its original amount. When the oxide was heated in oxygen instead of air, a gain of 15 per bent of available oxygen was observed taking place between 90° and 180° C. Veley thinks it probable that the gain of oxygen is not dependent on the accompanying loss of water.

In the paper above alluded to I state that the pure oxides examined did not become anhydrous after prolonged heating at 200° C., but retained at this temperature from 3 to 6* per cent of water. Wright and Luff did not recognise the retention of any water at 200°; but subsequently Wright and Menke ascertained that a certain amount of water was retained at 210° by each of the three specimens which they examined, the amounts being 0·86, 1·98, and 0·70 respectively. From 3 to 10 per cent of water was retained after drying at 100° C. Veley found that his oxides, when heated at 200° to 250° C. till constant in weight, retained 1·69 per cent of moisture, and again, in another experiment, when heated at 200° C., they retained about 2 per cent. All these numbers agree with my results in showing that the amount retained varies with different oxides, but differ from them in showing the retention to be far smaller than mine do. This difference is easily explained by the fact that Wright and Veley heated their oxides in a current of carefully dried air, whereas in my experiments the heating was performed in an ordinary air-bath where the air would be partially moist, my object not being to ascertain whether an oxide could by any possibility be dehydrated at these temperatures, but to prove the necessary inaccuracy of certain results obtained by Fisher.

§ XI. *Summary.*

In conclusion it will be well to summarise briefly the more important facts indicated by the above experiments.

1. A perfectly pure hydrated manganese oxide may be obtained by decomposing manganese sesquichloride with excess of water; this oxide, however, by no means contains the amount of oxygen theoretically contained in the dioxide.

2. In the oxides investigated, both pure and impure, the manganese present as dioxide bore to that present as monoxide ratios varying between 0·494 and 7·423, and they all (eight in number), with one exception, experienced an alteration in composition when heated to 100° or 200° C. In 6 out of the 7 cases this alteration was due to an evolution of oxygen; in the seventh case, to an absorption of that gas.

3. In all the cases investigated, where any change took place at 100°, this change was increased at 200° C.: but beyond this the extent of the loss at 100° C. does not afford any criterion as to what the loss at higher temperatures will be.

4. The results obtained with oxide No. 1, where experiments were made at six different temperatures, when represented diagrammatically form a curve of considerable regularity.

5. The composition of the oxide taken appears by no means to be the main factor in determining its behaviour on heating: the poorest oxide was not the one which experienced the greatest gain, nor was the richest oxide the one which experienced the greatest loss.

6. The amount of the alteration produced by heating appears to be greatly dependent on the amount of water present in the sample. The only oxide which experienced

---

* The first of these oxides was prepared by the action of bromine of manganous hydrate precipitated by soda and contained—

$$\frac{\text{Mn as MnO}_2}{\text{Mn as MnO}} = 4{\cdot}5.$$

The second by boiling nitric acid and permanganate, and contained—

$$\frac{\text{Mn as MnO}_2}{\text{Mn as MnO}} = 6.$$

Both of them probably contained a considerable amount of alkali (see *Journ. Chem. Soc.*, 1880, 25).

* 6 per cent was an extreme case; the average amount retained was about 4·1 per cent.

no change was the only one which was nearly anhydrous. The amount of change, however, even with oxides not differing much in composition from each other, is not entirely dependent on the amount of water present (*c.f.* oxides Nos. 4 and 5).

7. The oxides in which by far the greatest loss of oxygen took place on heating were those examined at once after their preparation and while still in an undried condition.

8. In the one case, however, where the same oxide was examined both before and after being dried, the loss experienced at 100° C. was found to be practically identical.

9. Whatever alteration took place was found to be practically complete in between half an hour and an hour and a half after the oxide had become mechanically dry.

10. Oxide No. 1 experienced no alteration on being kept in boiling water for some hours.

11. On repeatedly moistening and heating the oxide No. 1 the gain of oxygen at 100° C. was greatly increased. This increase depended on the number of times which the operation was repeated, amounting to seven times its original amount when repeated nineteen times.

12. The oxide No. 1, when heated at 100° in dry air, absorbs five times as much oxygen as when heated at the same temperature in air of 1·60 hygrometric state.

13. In the case of oxide No. 5 a considerable loss of oxygen was observed when heated in boiling water, this loss being complete in two and a half hours.

14. When No. 5 was heated at 100° C. in dry air instead of in partially moist air, the loss of oxygen was nearly doubled.

15. The oxides of manganese appear to undergo a molecular change on being kept in air for some length of time, whereby their behaviour on being heated is entirely reversed, a gain of oxygen instead of a loss taking place. This molecular alteration is unaccompanied by any change in composition. It was observed in four separate cases: the smallest time in which it had been observed to have taken place being (with the exception of the unreliable case of No. 8) fifty-eight days.

16. On heating small quantities of manganese oxides in a platinum dish over a Bunsen burner, the oxides obtained were found to be remarkably constant in composition, always containing rather more manganese than the sesquioxide does when the gas was at the day pressure. With a larger supply of gas less constant results were obtained, and some of these showed that a reduction considerably beyond Mn_3O_4 could in this way be obtained.

17. The experiments of Wright and Menke and of Veley agree with the present results in showing that a loss or gain of oxygen takes place at about 200° C., but they fail to show any alteration at temperature as low as 100° C. (the heating being performed in air).

18. Their experiments taken together show that the oxygen value is not in the main dependent on the richness of the sample taken, for the richest specimen suffered no loss at all at 210°, while poorer ones lost nearly 3 per cent of their total available oxygen.

19. The fact that the richest specimen lost no oxygen is probably due to its being nearly anhydrous.

20. The amount of water retained by the oxides at 100° and 200° C. is very variable; that retained in drying them in partially moist air at 200° C. is, according to the present experiments, 3 to 6 per cent; according to other authorities, the use of a current of perfectly dry air reduced it to 0·7 to 1·7 per cent.

Theory of Thermo-electric Motive Forces.—M. Pilleur.—The author suggests that the motor force of a thermo-electric element is proportional to the difference of the coefficients of thermic conductibility, under the influence of the temperature of the metals composing this couple, and to the difference of temperature of the point where the metals are soldered together and of the rest of the circuit.—*Les Mondes.*

ANALYSES OF RICE SOILS FROM BURMAH.

By R. ROMANIS, D.Sc., Chemical Examiner, British Burmah.

The analyses of rice soils was undertaken at the instance of the Revenue Settlement Survey, who wanted to know if the chemical composition of the soil corresponded in any way to the valuation as fixed from other evidence. It was found that the amount of phosphoric acid in the soil in any one district corresponded pretty well with the Settlement Officers' valuation, but on comparing two districts it was found that the district which was poorer in phosphoric acid gave crops equal to the richer one. On enquiry it was found that in the former the rice is grown in nurseries and then planted out by hand, whereas in the latter, where the holdings are much larger, the grain is sown broadcast. The practice of planting out the young crops enables the cultivator to get a harvest 20 per cent better than he would otherwise do, and hence the poorer land equals the richer.

The deductions drawn from this investigation are, first, that, climate and situation being equal, the value of soil depends on the phosphoric acid in it; and, second, that the planting-out system is far superior to the broadcast system of cultivation for rice.

Results of two analyses of soils from Syriam, near Rangoon, are appended.

Soluble in Hydrochloric Acid.

	I.	II. Virgin Soil.
Organic matter	4·590	8·508
Oxide of iron and alumina ..	8·939	7·179
Magnesia	0·469	0·677
Lime	trace	0·131
Potash	0·138	0·187
Soda	0·136	0·337
Phosphoric acid	0·100	0·108
Sulphuric acid..	0·025	0·117
Silica	—	0·005
	14·397	17·249

Soluble in Sulphuric Acid.

	I.	II. Virgin Soil.
Alumina	17·460	15·684
Magnesia..	0·459	0·446
Lime..	0·286	trace
Potash	0·616	1·250
Soda	0·317	0·285
	19·138	17·665

Residue.

	I.	II. Virgin Soil.
Silica, soluble	11·675	69·546
,, insoluble	49·477	
Alumina	3·062	4·178
Lime..	0·700	0·134
Magnesia..	0·212	trace
Potash	0·276	1·180
Soda	0·503	1·048
	100·000	100·000

These are alluvial soils from the delta of the Irrawaddy.

Hæmo-cyanine and its Distribution in the Animal Kingdom.— C. F. W. Krukenberg.—Both in blue blood, containing hæmo-cyanine and saturated with oxygen, and in the same rendered colourless by reduction, no characteristic distinctions are perceived with the spectroscope. When the hæmo-cyanic blood has been decolourised by carbonic oxide it is quickly rendered blue again if shaken up with atmospheric air.—*Med. Central-Blatt.*

ON THE DETERMINATION OF FAT IN MILK.

By S. P. SHARPLES, S.B.

The following method, first used by myself in 1874, and since followed by most of the chemists in this vicinity, was first published by me in the *Proceedings of the American Academy of Arts and Sciences*, December, 1875. I have found by repeated experiments that this method gives constant results. 5 grms. of the milk are evaporated in a flat platinum dish: the size I have most convenient is 65 m.m. in diameter and 15 m.m. deep. 5 c.c. of milk form a layer over the bottom of this about 2 m.m. thick, and when dry the layer is less than two-tenths of a millimetre thick. The bottom of the dish should be perfectly flat.

If 5 grms. of milk are placed in such a dish, there will first form on the surface a film, and then the drying will go on regularly and result in a honeycomb-like mass on the bottom of the dish. The process of drying will take about an hour and a half, and is best completed by fifteen minutes in the oven at 105° C. The dish is then weighed. It is then filled with petroleum benzine, and allowed to stand under a bell-glass for half an hour: this is then poured off, taking care not to lose any of the upper film, and the dish re-filled; this operation is twice repeated. The dish is then dried at 105° C., and again weighed; the loss gives the fat. The residue is then ignited, and gives the ash. All stirring of the milk before it is dry is carefully avoided.

The following are duplicate analyses made by this method, the sugar being determined by titration. The milk in the second case was seized as adulterated:—

	No. I.		No. II.	
Vol. per cent cream ..	18		6	
Specific gravity	1·030		1·021	
Sugar	4·19	4·19	3·45	3·45
Casein and albumen.. ..	5·17	5·23	2·79	2·78
Ash	0·72	0·72	0·47	0·48
Solids not fat	10·08	10·14	6·71	6·71
Fat	4·35	4·35	2·31	2·31
Total solids	14·43	14·49	9·02	9·02

The above form of reporting an analysis I have found is very convenient, and I have adopted regular printed blanks for the same, one of which I enclose. The following analysis is curious, as showing the effects of improper food upon the milk. It was made of milk taken from a herd of about 20 cows which had been fed on "stover corn." "Stover corn" is maize which has been thickly sown. It grows up very rapidly, and consists largely of water. Its use produces a large yield of milk of poor quality.

Milk taken September 6, 1877.

Specific gravity	1·026
Cream	10·00
Sugar	3·86
Caseine	3·31
Ash..	0·60
Solids not fat	7·77
Fat	3·07
Total solids	10·84
Water	89·16
	100·00

Boston, Mass., U.S., April 26, 1881.

New Synthesis of Sulph-hydantoine.—R. Andreasch.—This compound can be formed on heating thiaglycolic acid with cyanamide.—*Wiener Anzeiger*, 1880, 84 (22).

ON A PURE COKE.

By W. W. STAVELEY.

I have recently had occasion to test a sample of coke, made from coal-tar pitch, which I found to contain a very small percentage of sulphur. Since it is not generally known that coke of such purity is obtainable in large quantities, it may be well to record the analysis:—

Sulphur	0·12	0·11	
Ash	2·43	2·50	
Carbon	97·45	97·39	by difference

The sulphur was estimated by the prolonged boiling of the powdered coke, 5 to 6 grms., with nitric acid and a little chlorate of potash. The ash was estimated by heating for several hours in a Fletcher's muffle furnace at a white heat. The sample of coke was taken from the ovens and powdered whilst hot, thus ensuring the absence of moisture. Several determinations of sulphur and ash were made with similar results. A noticeable feature of this coke is that on exposure to the weather, even for months, it does not "slack" or disintegrate. This is no doubt due to the small percentage of sulphur present, the cause of the slacking of most cokes—gas-coke especially—being attributable to the oxidation of the sulphides of iron contained in the coke. The heating and burden carrying power of this coke in the furnace far exceeds that of the best Durham coke. From its hardness and close texture it is especially calculated to resist the action of the hot gases on the upper portion of the furnace, thus diminishing the loss.

LABORATORY NOTES FROM THE UNIVERSITY OF CINCINNATI.

Alkalimetry with Phenol Phthalein as Indicator.

By R. B. WARDER.

The properties of phenol phthalein, including the magnificent red colour which it yields with alkalies, were described by Baeyer* in 1871; but Luck† seems to have been the first to use it as an indicator. With caustic alkalies the delicacy of the reaction is marvellous; but when carbonates are present, the change of colour takes place more gradually, and cold solutions of an acid carbonate are not coloured at all. Even the carbonic acid of the atmosphere may have a marked influence.

For the following experiments a weighed quantity of a dark coloured sample of phenol phthalein from Kahlbaum was dissolved in weak alcohol, and a roughly graduated dropping tube was inserted in the stopper of the flask containing the solution, by which any required quantity of the indicator could be approximately measured out. 0·1 milligrm. of commercial phthalein was added to 100 c.c. distilled water, and $\frac{1}{100}$ normal NaOH solution was run in from a burette. With 0·4 c.c. $\frac{1}{100}$ n. alkali, the colour was barely perceptible; with 1 c.c. it was distinct, with 2 c.c. a beautiful faint pink colour was produced, which deepened to a distinct crimson red with 4 c.c. of the alkali. The colour produced by 1 or 2 c.c. could easily be discharged by shaking with air, and that produced by 4 c.c. was entirely discharged by less of my own breath than a single expiration; indeed, this experiment is well adapted for lecture demonstrations of the carbonic acid of the breath, being much more striking than the usual lime-water test. With different samples of ordinary distilled water, a varying amount of alkali was required to produce the succession of tints above described; the first appearance of colour is often very transient. The least quantity of alkali is required with water from which the carbon dioxide

---

* *Ber. der. Deut. Chem. Gessell.*, iv., 658.

† *Zeitsch. Anal. Chem.*, 1877, 332.

has been carefully expelled by heat, and it is convenient to have a supply of such water at hand in a well stoppered flask.

As a further test of the delicacy of this indicator, 20 c.c. of ½ normal alkali were carefully neutralised with oxalic acid (with boiling to expel CO_2), then diluted to about 100 c.c., and with the aid of 0·4 milligrm. phthalein a distinct tint was produced by the addition of 1 c.c. of $\frac{1}{100}$ normal NaOH, and a beautiful pink colour by less than 2 c.c. Hence, a variation of less than 0·1 per cent of the whole quantity of alkali used produced a marked change even in very dilute solution; with concentrated solutions the delicacy is much greater.

On adding acid to a cold dilute solution of sodic carbonate we may suppose the first reaction to take place thus:—

$$2Na_2CO_3+C_2H_2O_4=C_2Na_2O_4+2HNaCO_3\ ;$$

and as a solution of $HNaCO_3$ gives no colour with phthalein until it is decomposed by heat, we might expect the reddened solution of a carbonate to be entirely decolourised by ½ equivalent of acid. I have been able to realise this expectation only in part, yet the facts indicated serve as a basis for a method for the estimation of causticity of solutions which do not contain too large a proportion of carbonate. The alkaline solution, with a suitable quantity of phenol phthalein, is mixed with standard acid, in the cold, until the red colour either vanishes entirely, or (if the reaction is lacking in sharpness from the presence of carbonate) until the colour is extremely faint. Of course the solution must be sufficiently dilute to avoid any danger of effervescence in this first titration. The changes of tint closely resemble those observed when a solution of rosaniline is greatly diluted, and it is a valuable aid to the eye to keep such a solution at hand for comparison; and as the depth of colour at this stage varies with the quantity of indicator used, it is desirable to take some definite amount. After completing the first titration, the mixture is boiled thoroughly with successive additions of more acid, until the last returning trace of red colour is discharged by a single drop; or the end may be more quickly reached (in accordance with the law of the "action of mass") by boiling at once with excess of acid, and completing titration with the aid of caustic alkali. The end reaction in this case, which is very sharp, is marked by total discharge of colour.

Let A_1 = the acid required in first titration, and A_2 = that required in the second, with any needed deduction for the alkali used near the end; then A_1+A_2 represents the total alkali; A_1-A_2 represents the caustic alkali; $2A_2$ represents the carbonate.

The following titrations were made to test this method. Solutions used were:—(A) Oxalic acid, 0·991 normal; (B) standard sodic carbonate, ½ normal; (C) sodic hydrate, nearly ½ normal. 0·2 milligrm. phenol phthalein was used in each case.

The caustic soda was prepared by dissolving metallic sodium in water from which the carbon dioxide had been expelled. It was kept in a vessel provided with soda-lime ventilator, and was drawn without contact with the laboratory atmosphere, through the lower end of an ordinary burette, which was also provided with a soda-lime ventilator at the top.

Notwithstanding these precautions, a trace of carbonate appeared to be present in solution C, or to be formed during titration; for 42·22 c.c. of C were exactly decolourised in the cold by 21·39 c.c. of A; on boiling, the colour returned, and a further addition of 0·06 c.c. of the acid was required. By the formula given above, the caustic alkali present represents 21·39 − 0·06 = 21·33 c.c. of A, or 21·14 c.c. of perfectly normal acid. Hence we may assume that its strength in NaOH is 1·0014 × ½ normal with an admixture of Na_2CO_3 in the quantity used, equivalent to 2 × 0·06 = 0·12 c.c. of normal solution. Various mixtures of B and C were then titrated in the same manner. The following table expresses the volumes of these solutions used, as measured from burettes. A_1 is the quantity of acid required in the first titration, A_2 is the additional amount required when the solution was boiled:—

	B.	C.	A_1.	A_2.	A_1+A_2.	A_1-A_2.	$2A_2$.
(1.)	2·53	41·70	21·71	0·69	22·40	21·02	1·38
(2.)	4·90	39·65	21·33	1·30	22·63	20·03	2·60
(3.)	9·84	38·04	21·74	2·56	24·30	19·18	5·12
(3'.)	,,	,,	21·80	2·50	,,	19·30	5·00
(4.)	10·61	38·23	22·12	2·64	24·76	19·48	5·28

The following table shows the total alkali, the caustic alkali, and the carbonate taken, as represented in columns B and C, together with the corresponding quantities found by means of A_1+A_2, A_1-A_2, and $2A_2$. For convenience, these quantities are not calculated by weight, but are represented in c.c. of normal solution, as the object is merely to exhibit the experimental errors incident to this method. It is allowable to assume, in calculating these results, that each portion of C used contained the same quantity of Na_2CO_3 that was found in the preliminary titration:—

	Total Alkali.		NaOH.		Na_2CO_3.	
	Taken.	Found.	Taken.	Found.	Taken.	Found.
(1.)	22·25	22·20	20·86	20·83	1·38	1·37
(2.)	22·41	22·43	19·84	19·85	2·57	2·58
(3.)	24·08	24·08	19·03	16·01	5·04	5·07
(3'.)	,,	,,	,,	19·13	,,	4·96
(4.)	24·55	25·54	19·13	19·30	5·42	5·23

Two values of A_1 and A_2 are given for the third experiment. Those in line (3) correspond to a reading taken while there was still a faint reddish tinge, while (3') represents a complete discharge of colour in the first titration. The difference is not great, but a little practice will enable the operator to obtain still closer results. In experiment (4) the colour was quite inappreciable when the reading was taken; and the result shows that A_1 was rather too large and A_2 too small.

The use of phenol phthalein as an indicator, so strongly recommended by Luck, seems to have been somewhat neglected in consequence of the very property which is the basis of the method just described for distinguishing alkalinity and causticity. I think the convenience and accuracy of the new method will recommend it to those who have occasion to make such determinations; but, as its capabilities are not yet exhausted, I hope to continue the investigation, and ascertain whether the plan can be modified for the detection and estimation of carbonic acid in general.—*American Chemical Journal.*

PROCEEDINGS OF SOCIETIES.

PHYSICAL SOCIETY.

Saturday, May 14th, 1881.

Professor FULLER in the Chair.

NEW Members:—Mr. D. J. Blakely and Mr. Walter Kilner.

Prof. G. C. FOSTER read a communication from Prof. ROWLAND and Mr. E. H. NICHOLS, of Baltimore, U.S., on "*Electric Absorption in Crystals.*" According to the theory of Clausius, Maxwell, and others, there should be no electric absorption in the case of perfectly homogeneous substances. Prof. Rowland tested this deduction in the case of glass,—which is not quite homogeneous—quartz, and calcite. This was done by placing the material as the dielectric in a condenser formed of two amalgamated copper plates. The condenser was charged by six Leyden jars, and the absorption measured by a quadrant electro meter. The results were that quartz had about one-ninth the absorptive power of glass, and calcite none at all.

Dr. Hopkinson said that the *kind* of glass was important, and threw doubts on the theory that the absorption was due to heterogeneity. Paraffin wax had little absorptive power, and yet was very heterogeneous.

Professors Perry and Ayrton thought that two non-homogeneous substances in combination might have no residual charge.

Mr. Lewis Wright suggested that the optical character of crystals should be considered in these experiments which might be extended to other crystals. Calcite is uniaxial.

Prof. Minchin, of Cooper's Hill Engineering College, described his new absolute sine electrometer. This consists of two metal plates, in one of which is an aperature nearly closed by a metal trap-door suspended from the plate by two fine platinum wires, and resting against fine stops when the plates are hung vertically. These plates are connected to the poles of the cell to be measured, and tilted out of the vertical till the attraction of the whole plate on the suspended trap or shutter is just balanced by the weight of the latter. The electromotive force is then proportional to the line of the angle of displacement.

Dr. Lodge remarked, that the apparatus combined sensitiveness with practicality. The E.M.F. of a single cell could be measured by it, whereas Thomson's absolute electrometer could only give the total of a number of cells.

Prof. Ayrton stated, that he and Prof. Perry hoped to modify the instrument in the direction of sensitiveness by adding another plate and giving it a high charge.

Dr. Coffin suggested reversing the process by taking an observation.

Prof. Foster read a paper by Dr. J. E. Mills, "*On the Ascent of Hollow Glass Bulbs through Liquids.*" A glass ball of a pear shape rises through a liquid with a sensibly uniform velocity, which varies with the liquid. The time of ascent is proportional to the square of the diameter of the vessel, and depends of course on the specific gravity of the contents of the bulb. Dr. Mills measures the densities of gases and liquids in this manner.

Prof. Perry thought that the bulb should be of a shape having no re-entrant angles.

CORRESPONDENCE.

ESTIMATION OF FAT IN MILK.

To the Editor of the Chemical News.

Sir,—I have read with interest Mr. Carter Bell's reply to Mr. Hamlet's process for the Estimation of Fat in Milk. I quite agree with Mr. Bell, that it is *rather* ingenious, but extremely tedious (if not to say an extravagant process, certainly unnecessarily destructive), and in my opinion, there is more room for error in manipulation than in that of Wanklyn's. As regards the process described by Mr. Bell it is very accurate when carefully conducted, but the flasks are of so inconvenient a size that I shall now describe the process I have been in the habit of using, and in which is combined the common extraction method recommended by Mr. Hamlet, also the digestion by Mr. Bell. The plan I adopt is as follows:—10 grms. of milk are evaporated in a platinum boat (of suitable construction), to near dryness (to complete dryness if you wish to determine the total solids) in the water-bath; the boat is now inserted into the extraction tube (which is plugged with a little cotton-wool and contains a stopper in the narrow part of the tube), and then connected to an upright Liebig's condenser. A small tared flask is now fixed on to the end of the extraction tube (50 to 100 c.c. capacity) containing ether. The ether is evaporated by means of hot water, and when sufficiently condensed in the tube above, so as to completely cover the platinum boat, the stopper of the extraction tube is turned and the ether allowed to remain for about 6 hours or all night if convenient. All that now remains to be done is to cautiously open the stopper and allow the ether and oil to flow into the tared flask; boil the ether repeatedly until extraction is complete. Disconnect the flask, evaporate the ether dry, and weigh the oil. The platinum boat may also be taken from the extraction tube, dried in water-bath, and weighed, which will give the solids not fat, then ignited and weighed, and we have the ash. If there is any doubt in the mind of the operator, that the ether has not been able to penetrate the residue, after there have been several extractions made, the boat may be withdrawn from the extraction tube, the residue detached from its sides by means of a small platinum spatula, and the whole again returned to the extraction tube, and the operation of extraction repeated. When the extraction has been conducted as described, there is no fear of any fat being left undissolved in the residue. The following duplicate analyses are the results I have just obtained from a sample of milk I have reason to believe is genuine or unadulterated. The amount of milk operated upon was 10 grms. Specific gravity, 1027·3.

Total solids	10·2440	10·2448
Fat	1·9940	2·0001
Solids not fat	8·2500	8·2447
Ash	0·6940	0·6960

—I am, &c.,

William Johnston, F.I.C., F.C.S., &c.

Kings Lynn, May 11, 1881.

ESTIMATION OF FAT IN MILK.

To the Editor of the Chemical News.

Sir,—The methods for estimating fat in milk described by Mr. Hamlet in the Chemical News (vol. xliii., p. 170), and by Mr. J. Carter Bell on p. 194 of the same volume, are no doubt good and reliable; but for expedition and ease of execution they both, to my mind, must give place to extraction on Soxhlet's fat extractor, and I doubt whether they will give more accurate results.

If the small platinum basins are made of an oval shape they can be placed in the extractor, and when once the process has been started it can be left to go on for an almost indefinite time. To those whose duties frequently call them elsewhere, so that they cannot remain in the laboratory at all times, what can be more convenient than that they should be able to start the extraction before leaving, and return to find it finished?—I am, &c.,

Alfred Ashby, Public Analyst.

Grantham, May 10, 1881.

THE ESTIMATION OF PHOSPHORUS IN STEEL.

To the Editor of the Chemical News.

Sir,—Mr. J. Oliver Arnold, in his reply (Chemical News, vol. xliii., p. 209) to my criticisms of his paper, "On the Estimation of Phosphorus," gives some further details respecting his mode of operation. He has only himself to thank, if, in their absence, his results were apt to be misconstrued.

Mr. Arnold believes that a pyrophosphate would "undoubtedly" suffer complete conversion into orthophosphate, by evaporating its solution to a low bulk with hydrochloric acid. I am not prepared to deny that such would be the case, but I have my doubts, which will probably be shared by other chemists.

Similarly, it must be held that 50 c.c. of molybdic acid solution would be ample, and that because it cannot be correctly described in the words of Mr. Arnold as "a moderate excess."

The main point of Mr. Arnold's letter seems to be that his paper was intended to show that the molybdic acid method was untrustworthy, if certain well-known precautions were neglected, and that if these be adhered to, the method is so lengthy as to be of no practical value.

The correctness of the first part of this contention required no demonstration. The second part ignores the very essence of the process, which is not the rapidity with which results are obtained so much as the large weight of precipitate yielded by a minute quantity of phosphorus. Mr. Arnold says, "'Phosphorus' assumes that I get down the correct weight of the definite salt of phosphorus, and convert it into the magnesia salt, whereas I distinctly stated that the solution was boiled, and free molybdic acid obtained in addition to the phospho-molybdate." If Mr. Arnold will take the trouble to read my letter a second time, he will see that I referred to his first experiments, and that my general position is as follows:—

1. Eggertz's molybdic acid method gives accurate results when the necessary precautions are observed.
2. Mr. Arnold obtained low results because he neglected some of these precautions.
3. The value of Eggertz's method is that 1·63 m.grm. of phosphorus yield 100 m.grms. of precipitate.
4. Mr. Arnold sacrifices this advantage, and prefers to convert the phosphorus into 5·9 m.grms. of a precipitate which is not insoluble in the solutions employed. In this he errs in very good company, as exactly the same plan has been previously proposed by at least half-a-dozen other chemists.—I am, &c.,

Phosphorus.

May 14, 1881.

THE SO-CALLED "BUNSEN" PUMP.

To the Editor of the Chemical News.

Sir,—The letter of Dr. H. Sprengel on the above subject appears to me open to a little discussion, and especially on the subject of the credit due to the discoverer of a scientific principle and its application to the construction of a certain form of scientific apparatus, and that due or accorded to one who with far-sighted experience adapts such scientific principle or apparatus to the working of a process successfully, hitherto a faulty or deficient one.

Such an adaptation itself may be a work of genius, nay, it may be one only likely to occur to the mind of one, already possessed of a fund of experience in his own peculiar branch, possessed by no other living man.

Such adaption of a principle, to push the case somewhat farther, might be, in fact, a distinct benefit to mankind, in which case, certainly not so much the discoverer of the principle as the one who applies and adapts it to its widest range of usefulness, will be the one who will receive the grateful acknowledgments of the largest number, and this is but natural.

It would, from the foregoing, appear, then, that Prof. Roscoe, in using the words "to him (Bunsen) we are also indebted for the apparatus for accelerating filtrations, the Bunsen pump, &c.," was referring not to Sprengel's principle of the production of a vacuum by the flow of various liquids down specially constructed tubes, nor to his water-air-pump itself, but to Bunsen's filtering apparatus as a whole, in which the water-air-pump arrangement, confessed by Sprengel himself to be a comparative failure as an air-pump, is applied and combined so as to give a filter-pump which has been a brilliant success. The phrase employed by Dr. Sprengel in his letter,—"the satisfaction of being credited with having placed a useful servant at the disposal of Science and Industry"—is not quite free from objection, for as regards the water-*filter*-pump, to credit Dr. Sprengel with this would be a clear injustice to Bunsen. It was, in fact, Bunsen who adapted Sprengel's principle to the construction of this *filter*-pump and its appliances, and therefore it is Bunsen who deserves the thanks, so far, of Science and Industry, and it is natural that Bunsen's name should come to adorn this form of filtering apparatus. Sprengel conceived a general principle, and applied it with great success to the construction of a mercury air-pump, but the water-air-pump invented on the same principle was laid aside as a non-success, and nothing was done with it. Bunsen took it up, and adapted it to a new purpose, a new mode of filtration, and with every success, and the benefit he thus conferred being universal, he has earned universal gratitude, and his name has been affixed to the appliance. Thus Bunsen is much more than an "*employer*," he having adapted an instrument, so far without practical use, to a great and useful purpose. Bunsen also acknowledges the discovery of the principle, and also both mercury and water air-pumps fully enough, and no doubt all chemists do, and what more can be asked? If Dr. Sprengel's arguments were applied to the work of chemists, then in cases where a chemist discovers a new substance, but a technologist applies the same successfully for the first time, then the chemist should feel aggrieved, and contest the right of enjoyment of popular credit with the technologist or manufacturer who has applied it.

No one speaking of the Sprengel water air-pump, which as an air-pump was laid aside, could ever term it Sprengel's filter-pump without injustice to Bunsen; or were it generally stated that filtrations are made with the aid of Sprengel's pump, Bunsen's ingenious adaptation—in fact, invention—would be unjustly ignored thereby. Since without its application to filtering the water air-pump would have lain useless, this application is its most important feature, and the fact sufficiently explains the naming it as Bunsen's filter-pump or Bunsen's pump, in which no special merit is dreamt of merely as an air-pump and apart from its aid in filtration. I imagine, finally, every chemist knows well enough that the principle of rarefaction by means of the stream of water is due to Sprengel, and the application of the not too excessive exhaustion to the procees of filtration is Bunsen's, and this happening to be the cardinal virtue of the arrangement, the appliance is termed Bunsen's filter-pump.

With regard to the term "*Hero worship*" as applied to the "enumeration of the works of his friend Prof. Bunsen, by Prof. Roscoe in an an article in *Nature*, under the heading 'Scientific Worthies.'" As an old pupil both of Prof. Roscoe and Prof. Bunsen, I beg to protest against the use of such a term as exceedingly unjust and totally unfounded. Though it might perhaps, in some cases, be a little too much for the self control of some scientific worthies to recount the benefits conferred on science by their labours during their lifetime, in the case of Bunsen this is not so. Here is given a kindly tribute of friendship and respect for a man, than whom no other, perhaps, who has yet lived amongst men of science, has shown such an unselfish disregard for his own fame or standing in the opinions of the outside world, who has been so tardy in, or held back so much from, publication, or who has devoted so much of his best energies to the instruction and scientific welfare of his pupils.

Recollecting Bunsen for a moment, in his lecture-room in Heidelberg, and his unassuming, quiet demeanour there and in his laboratory, and his complete devotion there to the welfare, and indeed comfort and happiness, of his pupils, and the affectionate regard and esteem in which they hold him, and, finally, his numberless contributions to chemical and physical science, and then mindful of Prof. Roscoe's kindly tribute as an old friend and pupil, I am assured the great majority of Bunsen's host of past and present pupils would say, "It is all true, and even much is still left unsaid;" and as to the term "*Hero worship*," this sounds in connection therewith simply unmeaning. The rendering by one eminent man of science a tribute of friendly and grateful testimony in acknowledgment of quite exceptional claims of another,—in the present case of one with the most devoted and unselfish nature ever known amongst scientific men or great teachers of science—is an act simply indicative of an open and outspoken nature, willing and large minded enough to see and acknowledge what is good and great in others. Such a tribute comes all the more gracefully, however, from an old friend and pupil of Bunsen's, now the President of the Chemical Society of London, and here the stigma of "Hero worship" must fall completely to the ground.—I am, &c.,

Verax.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, l'Académie des Sciences. No. 14, April 4, 1881.

Alcoholate of Chloral.—M. Berthelot.—A thermic study, with especial reference to the heat liberated by the union of alcohol to chloral when this compound is formed in its three states, solid, liquid, and gaseous. In all these conditions the heat thus developed is greater than the corresponding heat of chloral hydrate.

Lightning without Thunder.—M. d'Abbadie.—The author describes a phenomenon of this kind which he witnessed in Africa when a thin fog occupying a narrow valley was suddenly illuminated by sheet lightning. He points out that in this case the ordinary explanation of so-called "heat lightning" as the mere reflection of a storm below the horizon is inapplicable.

Compounds of Phthalic Anhydride with the Hydrocarbons of the Benzol Series.—C. Friedel and J. M. Crafts.—The authors have in this manner obtained ortho-benzoyl-benzoic acid, para-toluyl-ortho-benzoic acid, and duroyl-benzoic acid.

An Account of Chalcomenite, a New Mineral Species.—MM. Des Cloizeaux and Damour.—This mineral, a copper selenite, is found in the mountains of Cacheuta, ten leagues to the south-west of Mendoza, in the Argentine republic, in company with selenides of lead, silver, and copper, differing greatly in their composition.

Researches on the Change of State in the Neighbourhood of the Critical Point of Temperature.—L. Cailletet and P. Hautefeuille.—The authors remark that near the critical point there are witnessed for very slight variations of temperature, phenomena which have led Andrews to regard the gaseous and the liquid states as distant terms of one and the same state of matter, which may pass from one to the other by a continuous series of changes. It is impossible to know what is the state of the matter which gives rise to the moving and wavey striæ which displace each other above the mercury on operating in the vicinity of the critical point. A slow decrease of pressure often shows if a tube is filled with a liquid or a gas, for in the latter case the release gives rise to a general mist and to liquid drops; but this procedure furnishes no clue to the nature of these striæ. The authors have overcome this difficulty by colouring carbonic acid with the blue oil of galbanum. They have found that these undulating striæ dissolve the oil, and are consequently produced by liquefied carbonic acid. They conclude that matter does not pass by insensible degrees from the liquid to the gaseous state.

Bismuthine Produced by Burning Coal-Mines.—M. Mayençon.—The author has obtained this mineral from the burning mines of Rosier, Montrembert, and Chavassieux. He has not been able to find it in the surrounding rocks, and suggests that it may have its origin in nodules of iron carbonate.

Change of Volume accompanying the Galvanic Deposition of a Metal.—E. Bouty.—The author has previously shown that galvanic deposits experience a variation of volume, whence results a pressure exerted upon the mould which receives them, and secondly that Peltier's phenomenon is produced at the surface of contact of an electrode and an electrolyte. He now finds that these two phenomena are connected, and that the first is a consequence of the second.

Viscosity of Gases.—William Crookes.—This memoir will be found in full in a forthcoming number of the *Annales de Chemie et de Physique*, and also in a forthcoming number of the *Philosophical Transactions.*

Luminous Intensities of the Radiations given off by Incandescent Platinum.—J. Violle.—If we take as unity the luminosity of incandescent platinum at 954°, at 1775° it is = 507.

Voltaic Conductivity of Heated Gases.—R. Blondlot.—According to the author's experiments there can be no doubt as to the voltaic conductivity of hot gases, even at temperatures much below redness, *e.g.*, at 60° to 70°. The current was obtained from a battery of five Bunsen elements.

Internal Discharges of Electric Condensers.—E. Villari.—The author's conclusions are that the heat evolved by the internal discharge may be neglected in case of feeble discharges; beyond certain limits it manifests itself and increases very rapidly with the discharges themselves; thus the first means to augment this internal heat is to make use of jars charged to a very high potential. The internal discharge is sensibly augmented if the exterior spark is produced between two small balls of 20 to 30 m.m. in diameter; it decreases, on the contrary, by almost one-half if the spark is taken from a point and one of the balls. The inverse is the case for the heat produced by the external exciting spark. For a given charge the internal discharge increases if the inner coating of the jar is diminished.

"Magic Mirrors."—L. Laurent.—The author states that a common silvered mirror, plane, convex, or concave, may be rendered very magical, and describes certain experiments in support of his assertion.

Sodium Hydrosulphite.—P. Schützenberger.—The author combats the views of M. A. Bernthsen on the composition of this salt.

Certain Novel Processes for Desulphurising Alkaline Solutions.—M. Scheurer-Kestner.—Not capable of useful abstraction.

Application of Chamber Crystals.—M. Sulliot.—The author finds that this compound, recommended as a disinfectant by MM. C. Girard and Pabst, gives off vapours too irritating for use in hospitals, &c. He proposes to render them supportable by placing the crystals in a porous cylindric vessel, surrounded by a second vessel containing alcohol. Vapours of nitrous ether are evolved.

Secondary and Tertiary Amylamines derived from the Active Amylic Acid of Fermentation.—R. T. Plimpton.—The author finds that between the active and the inactive secondary and tertiary bases there exist very marked differences. The boiling-points of the active bodies seem a little lower than those of the corresponding inactive bodies. Their hydrochlorates are syrupy and very deliquescent, whilst those of the inactive bodies crystallise easily and are not affected by the air.

Action of Phosphorus Perchloride upon Isobutylic Aldehyd.—S. Œconomides.—The principal product of the reaction is isobutylene chloride.

Preparation of Isobutylic Acetal.—S. Œconomides.—The author passes a current of hydrochloric acid into a refrigerated mixture of absolute alcohol and isobutylic aldehyd. The liquid separates into two layers, the upper one being a mixture of isobutylic acetal and chlorethyline.

Products of the Distillation of Resin.—A. Renard.—The author describes a new compound, boiling between 170° and 173°, and represented by the formula $C_{10}H_{10}$.

No. 15, April 11, 1881.

Ethyl Peroxide.—M. Berthelot.—This compound is prepared by passing through anhydrous ether a slow current of oxygen, absolutely dry, and strongly ozonised. The peroxide of ethyl remains as a dense syrupy liquid, miscible with water. If cooled down to −40° it becomes viscous, but does not crystallise. If heated in a glass tube it distils over in part, but the experiment terminates with a sudden and very violent explosion.

Liquefaction of Gaseous Mixtures.—MM. Cailletet and P. Hautefeuille.—In general the assimilation of the solution of a gas to its liquefaction is very imperfect, even in the case where the solution is completely destroyed by the action of a vacuum, for the evaporation-heat of a liquefied gas is always weaker than its solution-heat. We may therefore always suppose a chemical action when a gas dissolves in a liquid, but if this chemical action, as measured by the difference of the two heats just mentioned, is equal to the heat of contraction of the mixture of the two bodies taken in the liquid state, the assimilation becomes perfectly legitimate. The mixture of carbonic acid and cyanogen may be considered as the type of the liquids which the authors have been studying. This mixture preserves its characters at temperatures much higher than that which corresponds to the critical point of its more readily liquefiable element.

Vapour of Ammonium Bisulph-hydrate.—M. Isambert.—This compound is less volatile in presence of its elements than in a vacuum, or in an inert gas, like hydrogen.

Sulphur Chlorides, Bromides, and Iodides.—J. Ogier.—A thermo-chemical study on the formation of these compounds.

Les Mondes, Revue Hebdomadaire des Sciences.

No. 3, January 4, 1881.

New Schemes for Explaining Chemical Reactions.—Dr. Charles Brame.—The author introduces a new notation by which, he states, he has succeeded in attracting the attention of his pupils more perfectly than by the ordinary system. He suppresses the sign = and expresses separation by an arrow, placed horizontally or perpendicularly, and combination by a double-headed arrow. Thus, to explain the decomposition of mercury oxide by heat he writes $\textcircled{\text{Hg}} \div \bigcirc$.

No. 4, January 27, 1881.

Arrangements are made for the next meeting of the French Association for the Advancement of Science on April 14, at Algiers.

According to M. l'Abbé Barret the excessive resonance of churches may be diminished at pleasure by stretching iron wires across the dome.

Review of Recent Progress in Chemistry.—M. Gerber.—The author points out several errors and inaccuracies in the views of M. E. Maumené.

No. 5, February 3, 1881.

Werdermann's system of electric lighting has been tried successfully at Paris. The inventor makes use of pencils of carbon, perforated and lined within with an isolating medium.

A telephonic line between Seville and Fregenal, a distance of 150 kilos., has been established and put in successful action.

The Margarimeter.—An illustrated description of a recently-invented instrument for detecting foreign fats in butter. The apparatus is based upon the different specific gravity of butter and of fat. Its zero corresponds to pure butter, and each division above denotes an addition of 10 per cent of fat. The mark 100° signifies pure fat.

Crystallogenic Studies.—M. Charles von Hauer.—Not capable of useful abstraction.

No. 6, February 10, 1881.

This issue contains nothing novel in chemistry.

No. 7, February 17, 1881.

M. E. Hospitalier, in the *Nature Française*, gives an account of a telephone without wires, based upon the reflection of sound-waves.

Relations between the Atomic Weights of the Elements.—Maximilien Gerber.—Inserted at length.

Journal de Pharmacie et de Chimie.

December, 1880.

Plantations of Cinchonas Established by M. Vinson in the Island of Reunion.—The author has succeeded in establishing the valuable species *C. officinalis*, *C. succirubra*, and *C. Calisaya*.

The Spectroscope Applied to Chemistry and Pharmacy.—M. Collier.—A continuation.

Picric Acid and its Antiseptic Properties.—Dr. J. Cheron.—The author recommends picric acid in preference to phenol, since, having no odour of its own, it cannot mask dangerous effluvia.

The Place Occupied by Boron in the Series of Simple Bodies.—A. Etard.—Already noticed.

January, 1881.

On Papaine.—New Contribution to the History of Ferments.—A. Wurtz.—Already noticed.

Volumetric Determination of Butter.—Dr. A. Adam.—This memoir cannot be usefully abstracted without the accompanying illustration.

Treatment of Burns caused by Sulphuric Acid.—M. Alanore.—Two pupils of the Communal School of Clermont-Ferrand were severely burnt in the face with boiling sulphuric acid owing to the rupture of a retort. The author covered their faces with a soft paste made of calcined magnesia and water, and applied it in layers of 2 m.m. in thickness. As portions of the coating split off the paste was re-applied. All pain ceased in about a quarter of an hour, and after some time—five hours in the slighter of the cases, and twenty-four in the more severe—no further treatment was needful. Their faces show no trace of injury.

Determination of Small Quantities of Arsenic, Lead, and Copper in Urine.—M. Reichardt.—The destruction of the organic matter by chlorine is completely to be avoided. The urine is to be acidulated with a few drops of nitric acid, and treated for thirty to sixty minutes with a current of sulphuretted hydrogen till the liquid is saturated, and it is then left to settle in a covered vessel for twenty-four hours, and filtered. From 1 to 2 litres of urine may be employed for the experiment, and should be slightly warmed before introducing the gas. The presence of lead, bismuth, copper, and antimony is very rare; the filter is burnt when completely dry; the ash is melted with a mixture of soda and saltpetre, and the metals are sought for in the residue. For detecting arsenic, as soon as the urine saturated with hydrogen sulphide has been filtered, the filtrate is treated with bromine water, which converts the arsenic sulphide into arsenic acid; the excess of bromine is expelled by the application of a gentle heat, the arsenical deposit is converted into arsenic hydride, which is condensed in a solution of silver nitrate.

Bulletin de la Société Chimique de Paris,
No. 1, January 5, 1881.

Researches on Ozone.—P. Hautefeuille and J. Chappuis.—Already noticed.

Observations on an Iodometric Proceeding.—J. Pellieux and E. Allary.—The authors, in the description of their process (*Bull. Soc. Chim.*, 32, p. 273), speak of a preliminary calcination with soda-lime in cases where the substance analysed contains cyanides and thionic compounds, such as kelp. This calcination should last half an hour at a dull red heat. The quantity of soda-lime employed should be three or four times greater in weight than the sample operated upon. We may be sure that the calcination has been sufficient if an excess of hydrochloric acid, in presence of starch, immediately gives a blue colour. It is necessary, before proceeding to the determination with bromate, to destroy this blue tint, for which purpose a dilute solution of sodium sulphide is used. If traces of iron are present a faint yellow tint may remain after the destruction of the blueness.

Analyses of Sea-weeds.—E. Allary.—The quantity of iodine per 1000 kilos. of weed ranges from 1·224 kilos. to 0·077 kilo.

Sodium Boro-tungstates. — D. Klein. — Already noticed.

A New Organic Acid, the Benzoyl-propionic.—E. Burcker.—The author describes this acid, $C_{10}H_{13}O_3$, and its barium and iron salts.

No. 2, January 20, 1881.

Action of Phosphorus upon Hydriodic and Hydrobromic Acids.—A. Damoiseau.—Already noticed.

Detection of Alcohol in Transparent Soaps.—H. Jay.—It appears that every article manufactured with the aid of alcohol is required on its introduction into France to pay duty on the supposed quantity of this reagent which has been used in its preparation. Certain transparent soaps of German origin are now met with, made, as is alleged, without alcohol, and the author proposes the following process for verifying this statement by ascertaining the presence or absence of alcohol in the manufactured article:—50 grms. of soap are cut into very small pieces and placed in a phial of 200 c.c. capacity; 30 grms. sulphuric acid are then added, and the phial is stoppered and agitated till the soap is entirely dissolved. The phial is then filled up with water, and the fatty acids are allowed to collect and solidify. The subnatant liquid is drawn off, neutralised, and distilled. The first 25 c.c. are collected, filtered, and mixed, according to the process of MM. Riche and Bardy for the detection of alcohol in commercial methylenes, with ½ c.c. sulphuric acid at 18° B., then with the same volume of permanganate (15 grms. per litre), and allowed to stand for one minute. He then adds 8 drops of sodium hyposulphite at 33° B. and 1 c.c.of a solution of magenta, 1 decigrm. per litre. If any alcohol is present there appears within five minutes a distinct violet tinge. The presence of essential oils gives rise to a partial reduction of the permanganate without affecting the conversion of alcohol into aldehyd.

Action of Ethylene Bromide upon Toluene in Presence of Aluminium Chloride.—C. Friedel and M. Balsohn.—The products obtained are a mixture of isophthalic acid with a smaller proportion of terephthalic acid. Phthalic acid is absent.

Action of Sulphuric Acid upon Phenyl-acetylene.—C. Friedel and M. Balsohn.—The result of the reaction is methyl-benzoyl, the action of the sulphuric acid being a simple fixation of water.

Zymometer.—M. Zincholle.—An illustrated description of an instrument for testing the value of a sample of yeast and for examining the progress of fermentation. It is founded on the production of carbonic acid in a given time, which is the consequence of the reduction of maltose. The speed of the fermentation is inversely as the square of the weight of the yeast.

The Fluorine Salts of Tellurium.—A. Högbom.—An account of the potassium, ammonium, and barium salts.

Formation of Free Sulphuric Acid in the Gasteropods, especially in Dolium Galea.—R. Maly.—A liquid secreted by *Dolium Galea* contains 0·98 per cent of free H_2SO_4. Its origin is not explained.

No. 3, February 5, 1881.

Applications of Chamber Crystals.—C. Girard and J. A. Pabst.—The authors defend their proposals for the utilisation of these crystals against the criticism of M. Riche.

Platinous Hypophosphite.—R. Engel.—The author has obtained this compound by the action of hydrogen phosphide upon platinum tetrachloride. It is insoluble in water, alcohol, the hydrochloric, sulphuric, and acetic acids, but is oxidised and decomposed by nitric acid and chlorine water. It is decomposed at temperatures above 100°, giving off spontaneously inflammable hydrogen phosphide.

Detection of "Denaturated" Alcohol.—P. Cazeneuve and S. Cotton.—The authors propose as a reagent for the detection of so-called "methylated spirit," a mille-normal solution of permanganate. This solution is reduced slowly at common temperatures by pure ethylic alcohol, and also by pure methylic alcohol. But it is reduced instantaneously by the foreign bodies which ordinary methylic alcohol always contains.

Waldivine.—C. Tanret.—The author has obtained from the fruit of *Simaba Waldivia* a crystalline compound of the formula $C_{36}H_{24}O_{20}5HO$. It is neutral, non-volatile, possesses no rotatory power, dissolves most freely in chloroform, and is easily decomposed by alkalies.

Russian Chemical Society.—Session April 3/15, 1880, by M. A. Krakau.—M. Potilitzine made a communication on certain double decompositions which take place in the absence of water, proving that the phenomenon of distribution between the reacting bodies is in contradiction with the principle of maximum work, and that it depends on the values of the atomic weights of the metallic elements which take part in the reaction.

MM. Beilstein and Kurbatoff communicated researches on the petroleum of Bakou. They have proved the presence of hexa-hydro-meta-xylene in the portion boiling between 115° and 120°.

M. Latchinoff announces that choleo-camphoric acid if submitted to etherification or heated with sulphuric or hydrochloric acid, loses the elements of water, and is transformed into cholalic acid.

M. W. Alexéeff gave the results of further researches on the liquid camphor discovered by the late M. Wreden.

M. Schœne communicated a paper on the composition of hydrated barium peroxide.

M. Goldstein gave an account of his researches on the oxidation of the acetones.

M. Przybytek expounded his researches on the oxidation of erythrite, and presented a preliminary note on the oxidation of glycerine by means of nitric acid.

Revue Universelle des Mines, de la Metallurgie, &c.,
Tome 8, No. 3, November and December, 1880.

This number does not contain any original chemical matter.

Chemisches Central-blatt.
Vol. 11, No. 32.

Carbamid Sulphon-acetic Acid.—R. Andreasch.—This compound is formed by caustiously oxidising sulph-hydantoine with potassium chlorate and hydrochloric acid.—*Wiener Anzeiger*, 1880, 84-85.

Certain Transformation-Products of Rufigallic Acid and the so-called Oxyquinone.—Jos. Schreder.—On treating rufigallic acid with an excess of melting potassa the author obtained Malin's oxyquinone which, is a diphenyl derivative, along with salicylic, oxybenzoic, oxyterephthalic, and γ-oxyisophthalic acids.

Carbonic-oxide-hæmoglobine.—T. Weyl and B. v. Anrep.—The authors notice that oxidising agents have a much stronger action upon oxyhæmoglobine than upon carbonic-oxide-hæmoglobine.—*Archiv. Anat. and Physiol.*

Molecular Phenomena in Tin and Zinc.—C. Rammelsberg.—Not suitable for abstraction.

Vol. 11, No. 33.

Chemical Constitution of Milk.—MM. Danilewsky and Radenhausen.—Caseine is not a chemical individual, but a mixture of an albumen, probably identical with that of serum, and of certain protalb compounds.—*Schweiz. Ztschr. Pharmacie*, 1880, 22.

Influence of Light on the Transformation of Matter.—M. Speck.—From experiments made upon himself the author finds that the carbonic acid exhaled per minute in the dark and in the light are respectively as 100 : 104. The difference in the consumption of oxygen is merely as 100 : 101.—*Med. Central-Blatt.*

Behaviour of Ammonia in the Human Organism.—M. Coranda.—In man ammonia is transformed into urea, and the human organism, in respect to acids and alkalies, behaves like that of the carnivora.—*Med. C.-Blatt.*

Liberation of Heat during Digestion.—R. Maly.—This paper does not admit of useful abstraction.

Vol. 11, No. 34.

Direct Introduction of Carboxyl Groups into Phenols and Aromatic Acids.—C. Senhofer and C. Brunner.—The authors obtain from pyrogallic acid, by treatment with ammonium carbonate, two acids, the gallocarbonic and the pyro-gallo-carbonic.—*Wien. Anzeiger*, 1880, 93.

Resorcine as a Disinfectant.—J. Andeer.—Pure resorcine in a 1-100 solution completely checks the formation of Schizomycetes and is recommended as a caustic for morbid tissues.—*Med. C.-Blatt.*

Vol. 11, No. 35.

Decomposition of Barium Peroxide in a Vacuum at a Red Heat.—M. Boussingault.—Baryta at 450° and an ordinary pressure absorbs oxygen, and is dissociated in a vacuum at the same temperature.—*Ann. Chim. Physique.*

Products of Roasting Coffee.—O. Bornheimer.—The three chief products are solid fatty acids, caffeine, and caffeol, a heavy oil, which turns yellow on exposure to the air, and which is the vehicle of the aroma of coffee.

Vol. 11, No. 36.

Photo-polymerisation of Vinyl Bromide.—D. Looff.—The author has examined the influence of different solvents, and of iodine, water, and carbonic acid upon the photo-polymerisation of this compound.—*Z. Rusk. Chim. Obsé.*

Action of Zinc-ethyl upon Iso-butylene Bromide.—D. Looff.—The author obtained by this reaction amylbromide, boiling at 110° to 115°. He hopes, proceeding from this compound, to arrive at a new primary amylic alcohol.—*Z. Rusk. Chim. Obsé.*

Action of Nitric Acid upon Iso-tributylene.—D. Konovaloff.—On treating iso-tributylene with nitric acid the author obtains a compound which yields an amine on reduction.—*Z. Rusk. Chim. Obsé.*

A New Crystalline Hydrocarbon.—M. Chrapovicky.—The author obtainsd the body in question by the action of sodium upon the ethereal solution of tertiary butyl-iodide.—*Z. Rusk. Chim. Obsé.*

Tetrolic Acid.—G. Lagermark.—An account of the preparation of tetrolic chlor-anhydride.—*Z. Rusk. Chim. Obsé.*

On Oil of Lemon.—F. Flawitzky.—Commercial oil of lemon contains, in addition to the dextro-rotatory, a lævo-rotatory terpene, to the extent of not less than 10 per cent. The latter entirely agrees in its properties with the terpene of French oil of turpentine.—*Z. Rusk. Chim. Obsé.*

MEETINGS FOR THE WEEK.

Monday, 23dr.—Royal Geographical (Anniversary), 2.30.
Tuesday, 24th.—Civil Engineers, 8.
—— Royal Institution, 3 p.m. "Non-Metallic Elements," Prof. Dewar.
—— Medical and Chirurgical, 8.30.
Wednesday, 25th.—Society of Arts, 8.
—— Geological, 8.
Thursday, 26th.—Royal Institution, 3. "Magnetism," Professor Tyndall.
—— Quekett, 8.
Friday, 27th.—Royal Institution, 8. "Artificial Production of Indigo," Prof. H. E. Roscoe, 9.
Saturday, 28th.—Royal Institution, 3. "Russian Literature: Lermontoff," Prof. C. E. Turner.
—— Physical, 3.

THE CHEMICAL NEWS
AND
JOURNAL OF PHYSICAL SCIENCE.

Edited by WILLIAM CROOKES, F.R.S.

Published every Friday. Price 4d. Annual Subscription, post free including Indices, £1

CHARGES FOR ADVERTISEMENTS.

	£	*s.*	*d.*
Five lines in column (about 10 words to line)	0	3	6
Each additional line	0	0	6
Whole column	1	15	0
Whole page	3	0	0

A reduction made for a series of insertions.

Cheques and Post-Office Orders, crossed "London and County Bank," payable to the order of William Crookes.

BOY COURT LUDGATE HILL LONDON, E.C.

IRISH HILL BAUXITE (Alum Clay).

The **IRISH HILL MINING CO.** are now, and always have been, the LARGEST PRODUCERS OF THIS CLAY, of Superior Quality, and supply the Manufacturers of Alum, Sulphate of Alumina, and Alum-Cake, of the United Kingdom, America, and the Continent, almost exclusively.

Analysis by John Pattinson, Esq.

	Dried at 212° F.		
	Gertrude (extra qual.)	1st Quality.	2nd Quality.
Alumina	59·00	53·83	52·00
Peroxide of Iron	0·47	1·57	4·57
Silica	18·00	8·67	12·00
Titanic Acid		5·80	6·20
Lime, Magnesia, Potash, Soda, and Sulphuric Acid	0·23	0·83	1·14
Combined Water	22·30	29·27	24·00
	100·00	99·97	99·91

Our MINES, DRYING KILNS, and GRINDING MILLS are situated very close to the Shipping Ports of BELFAST and LARNE, and adjacent to Railways running alongside both Steamers and Sailing Vessels at both Ports, from either of which shipping is abundant and cheap, therefore we can guarantee Regular Delivery as Buyers require it, and are prepared to quote prices f.o.b. c.i.f., or delivered at any Port, in Bulk or Bags, Lump or Ground.

GEO. G. BLACKWELL, *Managing Director.*

Richmond Buildings, 26, Chapel St.,
Liverpool.

Established 1798.

ROBERT DAGLISH & CO.,

ENGINEERS, BOILER AND BRIDGE MAKERS, MILLWRIGHTS,

BRASS AND IRON FOUNDERS.

Manufacturers of every description of Condensing, or High-pressure Blowing, Pumping, Rolling, Winding, and Patent Steam-engines, of any required power, for Irrigating, Draining, Mining, Rolling Mills, or Water Works purposes, and Manufacturers of every description of Chemical, Colliery, Copper Ore, Gold Mining, Glass, and Rock-salt Machinery.

Black-ash Revolving Furnaces of the Most Approved Type.

Bessemer Steel-Rail Plant.

Compressing-Engines for Collieries, Iron Works, and Weldon's Patent Bleaching-Powder Process.

Caustic, Chlorate, Decomposing, Nitre Nitro-Glycerine, Iodine Potash, Sulphur, Acid, and Oxalic Pans.

Gas Producers Patent for Heating and other Purposes.

Pyrites Burners for Irish, Norwegian, and Spanish Ores of Improved Construction.

Patent Rousing Machinery for Brewers.

Retorts, Acid, Gas, Iodine, Nitric, Nitre Nitro-Glycerine and Vitriol Refining.

Steam Superheaters improved for Oil, Tar, and Resin Refining.

Steam Sulphur Melter.

Stills for Oil, Resin, and Tar.

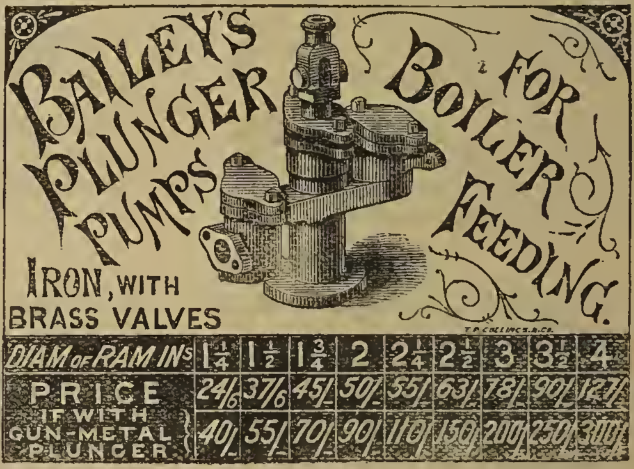
Wheels, Bevel, Mitre, and Spur Moulded on the Shortest Notice by Patent Machinery.

Makers of Mactear's Patent Carbonating Furnace, Jones and Walsh's Patent Sulphate of Soda Furnace, Parnell and Simpson's Patent Causticiser, and Kynaston's Patent Alum Plan

Lists sent on Application.

Photographs, Plans, and other information supplied on receipt of Order.

ST HELEN'S ENGINE, BOILER, AND BRIDGE WORKS
AND FOUNDRY,
LANCASHIRE.



Diam of Ram Ins	1¼	1½	1¾	2	2¼	2½	3	3½	4
Price	24/6	37/6	45/	50/	55/	63/	78/	90/	127/
If with Gun-Metal Plunger	40/	55/	70/	90/	110/	150/	200/	250/	300/

BAILEY'S WATER MOTORS.

BAILEY'S HYDRAULIC LIFTS.

BAILEY'S INJECTORS.

Albion Works, Salford, Manchester.

TETRACHLORIDE OF CARBON.
BISULPHIDE OF CARBON.
CHLORIDE OF SULPHUR.

JESSE FISHER & SON,
Phœnix Chemical Works Ironbridge.

THE CHEMICAL NEWS.

Vol. XLIII. No. 1122.

ON DISCONTINUOUS PHOSPHORESCENT SPECTRA IN HIGH VACUA.[*]

By WILLIAM CROOKES, F.R.S.

In a paper which I had the honour of presenting to the Royal Society in March, 1879,[†] I drew attention to the fact that many substances, when in high vacua and submitted to the molecular discharge by means of an induction coil, emitted phosphorescent light; and I especially mentioned the phosphorescent sulphides, the diamond, the ruby, and various other forms of alumina, crystalline and amorphous.

Pure alumina chemically prepared has very strong phosphorescence. Sulphate of alumina is dissolved in water, and to it is added an excess of solution of ammonia. The precipitated hydrate of alumina is filtered, washed, ignited, and tested in the molecular stream. It phosphoresces of the same crimson colour, and gives the same spectrum as the ruby.

Alumina in the form of ruby glows with a full rich red colour, and when examined in the spectroscope the emitted light is seen to be discontinuous. There is a faint continuous spectrum ending in the red somewhere near the line B; then a black space, and next an intensely brilliant and sharp red line, to which nearly the whole of the intensity of the coloured glow is due. The wave-length of this red line, which appears characteristic of this form of alumina, is, as near as I can measure, λ 689·5 m.m.m. This line coincides with the one described by E. Becquerel as being the most brilliant of the lines in the spectrum of the light of alumina in its various forms, when glowing in the phosphoroscope.

This coincidence is of considerable interest, as it shows a relation between the action of molecular impact and of sunlight in producing luminosity. The phosphorescence induced in a crystal of ruby by the molecular discharge is not superficial, but the light comes from the interior of the crystal, and is profoundly modified according as its direction of vibration corresponds or makes an angle with the axis of the crystal, being quenched in certain directions by a Nicol prism.

Sunlight falling on the ruby crystal produces the same optical phenomena. The light is internally emitted, and on analysis by a prism is seen to consist essentially of the one brilliant crimson line, λ 689·5. This fact may account for the extraordinary brilliancy of the ruby, which makes it so highly prized as a gem. The sun not merely renders the red-coloured stone visible, as it would a piece of coral, but it excites the crystal to phosphorescence, and causes it to glow with a luminous internal light, the energy of which is not diffused over a broad portion of the spectrum, but is chiefly concentrated into one wave-length.

The crimson glow of alumina remains visible some time after the current ceases to pass. When the residual glow has ceased it can be revived by heating slightly with a spirit-lamp.

After long experimenting with chemically pure alumina precipitated from the sulphate as above described, a curious phenomenon takes place. When sealed up in the vacuum two years ago it was snow white; but after being frequently submitted to the molecular discharge for the purpose of exhibiting its brilliant phosphorescence, it gradually assumes a pink tinge, and on examination in sunlight a trace of the alumina line can be detected. The repeated molecular excitation is slowly causing the amorphous powder to assume a crystalline form.

Under some circumstances, alumina glows with a green colour. Ammonia in large excess was added to a dilute solution of alum. The strong ammoniacal solution filtered from the precipitated alumina was now boiled. The alumina which the excess of ammonia had dissolved was thereby precipitated. This was filtered off, ignited, and tested in the molecular discharge. It gave no red light whatever, but phosphoresced of a pale green, and on examination with a prism the light showed no lines, but only a concentration of light in the green.

Two earthen crucibles were tightly packed, the one with sulphate of alumina, the other with acetate of alumina. They were then exposed, side by side, to the most intense heat of a wind furnace—a heat little short of the melting-point of platinum.[*] The resulting aluminas were then tested in the molecular stream.

The alumina from the sulphate gave the crimson glow and spectrum line.

The alumina from the acetate gave no red glow or line, but a pale green phosphorescence.

In my examination of rubies, many pounds of which have passed through my apparatus, I have been fortunate enough to meet with one solitary crystal, not to the eye different from others, which emits a *green* light when tested in the molecular stream. All others act as I may call normally. The spectrum of this green-glowing crystal shows, however, a trace of the red line, and on keeping the discharge acting on it for a few minutes the green phosphorescence grows fainter and a red tinge is developed, the spectrum line in the red becoming more distinct.

Besides the Ruby, other native forms of crystallised alumina phosphoresce. Thus corundum glows with a pink colour. The sapphire appears to be made up of the red-glow and the green-glow alumina. Some fine crystals of sapphire shine with alternate bands of red and green, arranged in layers perpendicular to the axis. Unfortunately it is impossible to prepare a tube for exhibition containing this variety of sapphire, as it is constantly evolving gas from the numerous fissures and cavities which abound in this mineral.

The red glow of alumina is chiefly characteristic of this earth in a free state. Few of its compounds, except Spinel (aluminate of magnesium), either natural or artificial, show it in any marked degree. All the artificially crystallised aluminas give a strong red glow and spectrum line. An artificially crystallised aluminum and barium fluoride phosphoresces with a blue colour, but shows the red alumina line in the spectrum. Spinel glows red, and gives the red line almost as strong as the ruby.

The mineral Spodumene (an aluminium and lithium silicate) phosphoresces very brilliantly with a rich golden yellow colour, but shows no spectrum line, only a strong concentration of light in the orange and yellow. A phosphorescing crystal of Spodumene has all the internal light cut off with a Nicol prism, when the long axes of the Nicol and the crystal are parallel.

It became of interest to see if the other earths would show phosphorescent properties similar to those of alumina, and especially if any of them would give a discontinuous spectrum; considerable interest attaching to a solid body whose molecules vibrate in a few directions only, giving rise to spectrum lines or bands on a dark background.

Glucina prepared with great care is found to phosphoresce with a bright blue colour, but no lines can be detected in the spectrum, only a concentration of light in the blue.

The rare mineral phenakite (aluminate of glucinum), sometimes used as a gem, phosphoresces blue like pure glucina, no trace of the alumina line being found in its spectrum. This mineral shows a residual glow after the current is turned off.

Thorina has very little, if any, phosphorescence. This earth is, however, remarkable for its very strong attraction for the residual gas in the vacuum tube. On putting

---

[*] A Paper read before the Royal Society, May 19, 1881.

[†] *Phil. Trans.*, Part 2, 1879, p 660.

[*] This operation was kindly performed for me by Messrs. Johnson and Matthey.

thorina in a tube furnished with well-insulated poles whose ends are about a millimetre apart in the centre, and heating strongly during exhaustion, the earth on cooling absorbs the residual gas with such avidity that the tube becomes non-conducting, the spark preferring to pass several inches in air rather than strike across the space of a millimetre separating the two poles. It is probable that this strong attraction for gas is connected with the great density of the earth thorina (sp. gr. = 9·4).

Zirconia gives a very brilliant phosphorescence, approachin intensity that of sulphide of calcium. The colour is pale bluish green, becoming whiter as the intensity of the discharge increases: no lines are seen in its spectrum.

Lanthana precipitated as hydrate and ignited shows no phosphorescence. After it has been heated for some time before the blowpipe it phosphoresces of a rich brown.

Didymia, from the ignition of the hydrate, has scarcely any phosphorescence; what little there is appears to give a continuous spectrum with a broad black band in the yellow-green. On examining the light reflected from this earth when illuminated by day or artificial light, the same black band is seen, and with a narrow slit and sunlight the band is resolved into a series of fine lines, occupying the position of the broadest group of absorption lines in the transmission spectrum of didymium salts.

Yttria shows a dull greenish light, giving a continuous spectrum.

Erbia phosphoresces with a yellowish colour, and gives a continuous spectrum, with the two sharp black bands so characteristic of this earth cutting through the green at λ 520 and 523. These lines are easily seen in the light reflected from erbia when illuminated by daylight. It is well known that solid erbia heated in a flame glows with a green light, and gives a spectrum which chiefly consists of two bright green lines in the same place as the dark lines seen by reflected light.

A curious phenomenon is presented by erbia when the spark passes over it at a high exhaustion. The particles of earth which have accidentally covered the poles are shot off with great velocity, forming brightly luminous lines, and, striking on the sides of the tube, rebound, remaining red-hot for an appreciable time after they have lost their velocity. They form a very good visible illustration of Radiant Matter.

Titanic acid phosphoresces dark brown, with gold spots in places.

Stannic acid gives no phosphorescence.

Chromic, ferric, and ceric oxides do not appreciably phosphoresce.

Magnesia phosphoresces with a pink opalescent colour, and shows no spectrum lines.

Baryta (anhydrous) scarcely phosphoresces at all. Hydrated baryta, on the contrary, shines with a bright orange-yellow light, but shows no discontinuity of spectrum; only a concentration in the yellow-orange.

Strontia (hydrated) phosphoresces with a beautiful deep blue colour, and when examined in the spectroscope the emitted light shows a greatly increased intensity at the blue and violet end, without any lines or bands.

Lime phosphoresces of a bright orange-yellow colour, changing to opal-blue in patches where the molecular discharge raises the temperature. In the focus of a concave pole the lime becomes red- and white-hot, giving out much light. This earth commences to phosphoresce more than 5 millims. below the vacuum, and continues to grow brighter as long as the electricity is able to pass through the tube. On stopping the discharge there is a decided residual glow. No lines are seen in the spectrum of the light.

Calcium carbonate (calcite) shows a strong phosphorescence, which begins to appear at a comparatively low exhaustion (5 m.m.). The interior of the crystal shines of a bright straw colour, and the ordinary and extraordinary rays are luminous with oppositely polarised light. Calcite shows the residual glow longer than any substance I have as yet experimented with. After the current has been turned off the crystals shine in the dark with a yellow light for more than a minute.

Calcium phosphate generally gives an orange-yellow phosphorescence and a continuous spectrum. Sometimes, however, a yellow-green band is seen superposed on the spectrum.

Potash phosphoresces faintly of a blue colour. The spectrum shows a concentration at the blue end, but the light is too faint to enable lines, if any, to be detected.

Soda phosphoresces faintly yellow, and give the yellow line in the spectrum.

Lithium carbonate gives a faint red phosphorescence. Examined in the spectroscope, the red, orange, and blue lithium lines are seen.

I have already said that the diamond phosphoresces with great brilliancy. In this respect perfectly clear and colourless stones "of the first water" are not the most striking. and they generally glow of a blue colour. Diamonds which in sunlight have a slight fluorescence disappearing when yellow glass is interposed, generally phosphoresce stronger than others, and the emitted light is of a pale yellowish green colour.

Most diamonds which emit a very strong yellowish light in the molecular discharge give a continuous spectrum, having bright lines across it in the green and blue. A faint green line is seen at about λ 537; at λ 513 a bright greenish blue line is seen, and a bright blue line at λ 503. A darkish space separating the last two lines.

Diamonds which phosphoresce red generally show the yellow sodium line superposed on a continuous spectrum.

There is great difference in the degree of exhaustion at which various substances begin to phosphoresce. Some refuse to glow until the exhaustion is so great that the vacuum is nearly non-conducting, whilst others commence to become luminous when the gauge is 5 or 10 millimetres below the barometric level. The majority of bodies, however, do not phosphoresce till they are well within the negative dark space.

During the analysis of some minerals containing the rarer earths experimented on, certain anomalies have been met with, which seem to indicate the possible presence of other unknown elements awaiting detection. On several occasions an earthy precipitate has come down where, chemically speaking, no such body was expected; or, by fractional precipitation and solution, from a supposed simple earth something has separated which in its chemical characters was not quite identical with the larger portion; or, the chemical characteristics of an earth have agreed fairly well with those assigned to it in books, but it deviated in some physical peculiarity. It has been my practice to submit all these anomalous bodies to molecular bombardment, and I have had the satisfaction of discovering a class of earthy bodies which, whilst they phosphoresce strongly, also give spectra of remarkable beauty.

The spectrum seen most frequently is given by a pale yellowish coloured earth. It consists of a red, orange, citron, and green band, nearly equidistant, the citron being broader than the others and very bright. Then comes a faint blue, and lastly two very strong blue-violet bands. These bands, when seen at their best, are on a perfectly black background; but the parent earth gives a continuous spectrum, and it is only occasionally, and as it were by accident, that I have so entirely separated it from the anomalous earth as to see the bands in their full purity. Another earthy body gives a spectrum similar to that just described, but wanting the red, and having a double orange and double citron band. A third gives a similar spectrum, but with a yellow line interposed between the double orange and the double citron, and having two narrow green lines.

At present I do not wish to say more than that I have strong indications that one, or perhaps several new elements are here giving signs of their existence. The quantities I have to work upon are very small, and when each step in the chemical operation has to be checked by an appea to the vacuum tube and to the induction coil the progress is tediously slow. In the thallium research it only occupied a few minutes to take a portion of a precipitate on a platinum loop, introduce it into a spirit-flame, and look in the spectroscope for the green line. In that way the chemical behaviour of the new element with reagents could be ascertained with rapidity, and a scheme could be promptly devised for its separation from accompanying impurities. Here, however, the case is different: to perform a spectrum test, the body under examination must be put in a tube and exhausted to a very high point before the spectroscope can be brought to bear on it. Instead of two minutes, half a day is occupied in each operation, and the tentative gropings in the dark, unavoidable in such researches, must be extended over a long period of time.

The chemist must also be on his guard against certain pitfalls which catch the unwary. I allude to the profound modification which the presence of fluorine, phosphorus, boron, &c., causes in the chemical reactions of many elements, and to the interfering action of a large quantity of one body on the chemical properties of another which may be present in small quantities.

The fact of giving a discontinuous phosphorescent spectrum is in itself quite insufficient to establish the existence of a new body. At present it can only be employed as a useful test to supplement chemical research. When, however, I find that the same spectrum-forming earthy body can always be obtained by submitting the mineral to a certain chemical treatment; when the chemical actions which have separated this anomalous earth are such that only a limited number of elements can possibly be present; when I find it impossible to produce a substance giving a similar discontinuous spectrum by mixing together any or all of the bodies which alone could survive the aforesaid chemical treatment;—when all these facts are taken into consideration, and when due weight is given to the very characteristic spectrum reaction, I cannot help concluding that the most probable explanation is that these anomalies are caused by the presence of an unknown body whose chemical reactions are not sufficiently marked to have enabled chemists to differentiate it from associated elements.

STEEL FOR THE MANUFACTURE OF DIES.[*]

By Prof. W. CHANDLER ROBERTS, F.R.S.

[The following article was originally written as a departmental report only. The suitability of steel for the manufacture of dies has been so little examined, and the peculiar conditions die-steel has to meet are so little understood, that we gladly avail ourselves of Professor Roberts's permission to reprint the article.—*Ed.* C.N.]

I have referred in former Reports[†] to the question of steel for the manufacture of dies, and attention has frequently been drawn to the difficulty experienced in obtaining metal of suitable quality. Our knowledge of the relation between the chemical composition and the mechanical properties of steel may almost be said to have been created since 1849, when the late Professor Brande stated, in evidence before the Royal Commission on the Mint, that he had analysed numerous varieties of steel, but ascribed its peculiarities more to mechanical texture than to chemical composition.[‡] Not long since the appearance of the fracture of a sample of metal was considered to afford trustworthy and sufficient evidence as to its nature and properties; but such rough methods have now given place to the rigorous physical, chemical, and mechanical investigations to which metals must be submitted as a matter of ordinary routine.

Although the steel at present supplied to the Mint appears to show a marked improvement in the number of coins struck per pair of dies, the difficulty involved in the production of a suitable quality of steel demands careful attention, and it appears probable that an examination of the many advances in the metallurgy of steel that have been made in recent years cannot fail both to indicate the chemical and physical conditions which a die-steel should satisfy, and to show the direction in which advance in its manufacture should be sought.

In regard to the first of these points it must be admitted that the information to be gathered is but limited; for, notwithstanding the elaborate system of tests above referred to, eminent authorities on the subject hold that the recognised tests should be supplemented by experiments in which the metal is actually employed for the purpose for which it is required.

It will be well first to briefly examine the chemical conditions which influence the resistance of metal to mechanical strain. Carbon, it is well known, gives to iron fusibility and renders it capable of being cast in moulds. The result of very many experiments appears to show that the presence of 0·15 per cent of carbon converts wrought-iron into steel, rendering it capable of being slightly hardened; beyond 1·5 per cent of carbon the metal ceases to be malleable, and is known as cast-iron. The influence of this metalloid on the tensile strength is, moreover, very remarkable. Thus, an increase from 0·15 to 0·18 per cent of carbon will suffice to increase the breaking strain by several tons per square inch. Manganese is generally considered to act in a similar manner to carbon,[*] but in certain cases it is found to be specially beneficial in that it makes the metal forge more readily.

Silicon appears to render steel fragile under impact and diminishes its resistance to traction. A small quantity of this element is, however, serviceable in rendering the material known as "ingot-metal" free from blow-holes. With regard to sulphur and phosphorus it is admitted that the presence of these metalloids is on the whole prejudicial, but their influence need not be specially dwelt upon here, as they do not occur in sensible quantities in the high qualities of steel which can alone be used for the manufacture of dies.

The effect of the simultaneous presence of two or more of the above-mentioned elements in steel is extremely complex, and often uncertain, so that it must be long before we can hope for a complete solution of the question. It therefore becomes necessary to consider specific cases.

The following analyses of typical samples of steel employed in the Mint for dies were made by Mr. W. F. Ward, my Assistant in the Metallurgical Laboratory of the Royal School of Mines:—

	A.	B.	C.	D.
Iron	98·93	98·63	98·64	by diff. 98·07
Carbon	0·82	1·07	0·79	1·19
Manganese ..	0·10	0·12	0·24	0·45
Silicon	0·05	0·06	0·18	0·29
Sulphur	trace	trace	0·01	trace
Phosphorus ..	—	trace	0·01	trace
Copper	—	—	0·02	—
	99·90	99·88	99·89	100·00

The sample marked A was a die of exceptional quality' having struck no less than 200,000 florins, the normal out-turn of a florin die not exceeding 50,000 pieces. B is the steel now employed, which, during the past year, has been found to yield an average out-turn of 54,000 pieces per pair of dies. C proved in practice to be of unsatisfactory quality, owing to the frequency with which it cracks during the operation of hardening, and this fault was still

---

[*] Reprinted from the "Eleventh Annual Report of the Deputy Master of the Mint."

[†] Report on European Mints; Parliamentary Paper 466 (1870), p. 27; Eighth Annual Report (1877), p. 40; Ninth Annual Report (1878), p. 39.

[‡] Minutes of Evidence, Royal Mint Commission, 1849, p. 181.

[*] "Les Métaux a l'Exposition Universelle de 1878." Par H Lebasteur, Paris, 1878, p. 74.

more marked in the sample D. Their use has therefore been discontinued.

It is unquestionable that the variations in the amounts of the constituent elements indicated by the above analyses to some extent explain the relative merits of the samples. As has already been stated, the property of hardening is mainly due to the presence of carbon; indeed Chernoff, Siemens, and many others are of opinion that true steel is a mixture or combination of carbon and pure iron alone, and that all other substances are impurities necessarily injurious in pure steel, though sometimes apparently beneficial if they exclude or neutralise more injurious substances.[*] Deshayes[†] has shown that the broad groupings into which steels may be divided (on the basis of their tensile strength) are characterised by marked, although gradual, differences in the amount of carbon they contain. This metalloid is the one on which the mechanical properties centre, and the elaborate researches of the distinguished engineer whom I have just mentioned seem to point to the fact that a steel containing from 0·6 to 0·75 per cent of carbon will be found best suited for the manufacture of dies, providing the amount of other metalloids present is satisfactory. Bearing in mind the fact already alluded to, that a difference of only 0·03 per cent in the carbon is known to materially alter the tensile strength, it seems reasonable to conclude that the inferiority of sample B as compared with A may be mainly attributed to the amount of carbon it contains. In regard to sample C, the amount of manganese and silicon is relatively high, and it may be confidently asserted that there is sufficient chemical reason for its marked failure as a material for dies. It would appear probable that the physical conditions to which it has been subjected in hardening and tempering were unsuitable, and have also contributed to such a result. With reference to D, the manganese and silicon are exceptionally high, and it is obviously, therefore, far removed from the class of steel that past experience has shown to be suitable.

The question will be seen to be one of extreme complexity, and even when the examination of the metal is limited to its actual employment for the purpose for which it is required, there still remain a great number of conditions, the influence of each of which has to be investigated. Taking the metal as received in square bars from the manufacturers, the operations to which it is subjected in conversion into dies are—forging, turning, striking, hardening, tempering; and the influence of variations in such of these processes as can be varied should be examined while all others remain constant. Thus in his Memorandum for last year,[‡] Mr. Hill adduced some figures tending to show that dies forged by the steam-hammer afford better results than those forged by hand; and in his Memorandum for 1876[§] a table is given, from which it appears that the form of press used also exercises a material influence. It is, however, well to remember, in considering such a question, that the quality of different bars, even from the same parcel, varies both in regard to their chemical and physical properties; indeed it is now recognised that the same bar may be expected to vary throughout its length. This would alone account for the well-known fact that dies made of the same metal differ widely in the number of coins they produce before cracking, and it points to the necessity of only drawing conclusions from as large a number of experiments as possible.

It would appear that the extensive experience of the Mint in the use of steel for dies might be expected to afford valuable information as to the conditions to be satisfied by the metal in order that it may be specially adapted for such a purpose; but the many slight variations of condition, the difference in the denomination of coin struck (and therefore in the pressure applied), and in the character of coining-press used, render it impossible to draw other than general conclusions from the ordinary work of the Department.

Turning to the general investigations which have been made into the resistance of metals, it is to be observed that very little information is available which can be regarded as strictly bearing on the question of dies. The direct tests for resistance to impact—as, for example, those applied to armour-plates—cannot be considered to afford a guide in the selection of steel for such a purpose; and even if they could be accepted in relation to impacts like those of a coining-press, the operation of hardening is of so delicate a nature, and its influence on the physical properties of the metal is so little understood that any conclusions would probably require considerable modification in practice.

Nevertheless, it may be well to note the basis on which these tests are made. Kirkaldy[*] concludes, as the result of experiments, that the contraction per cent where rupture occurs in the usual form of test-piece affords very trustworthy information as to the value of steel. Prof. Åkerman,[†] of Stockholm, takes the fraction formed by dividing the limit of elasticity (usually expressed in tons per square inch) by the breaking strain, expressed in the same terms, as a coefficient, and Deshayes[‡] prefers to adopt the difference between these two numbers as a measure of the power of a given sample of steel to resist impact.

It is, however, important to notice that the coefficient here referred to indicates the extreme force which the metal will support, and thus cannot be applied to the case of a die, which is subjected to a prolonged series of impacts, the force of which is considerably under that at which crushing would occur. A somewhat analogous case—that of steel in a constant state of vibration, as the springs of railway carriages—has been investigated by Wöhler,[§] and he concludes that the difference in the tension of the metal at the extreme limits of each vibration may be taken as a measure of its resistance. He further states that the amount of the tension may be increased in proportion as this difference becomes less.

It is to be observed that Åkerman's criterion for resistance to impact is also a criterion for ductility, for the smaller the ratio $\frac{L}{R}$ (L being the limit of elasticity and R the breaking load) becomes, the greater is the force beyond the limit of elasticity that the substance can resist without fracture, and the tougher accordingly it is. But in hardened steel the limit of elasticity is increased so as to approximate to the breaking load, and the ductility together with the resistance to shock will thus diminish, as is indicated by the increase in the value of the fraction $\frac{L}{R}$. This fraction appears to afford one datum for determining the properties that characterise a good die-steel, but Åkerman himself points out that it has not yet been sufficiently studied even by engineers, and it is impossible for me to say how far it bears on the question under consideration.

In addition to resisting shock, a die-steel is required to satisfy yet another important condition. It must retain the precise form given to it, so that the engraved device is not distorted by the impact; or, in other words, the steel must have a high limit of elasticity. As is well known, and as is indicated in the subjoined table, such a condition is best satisfied by hardening the metal, but, when this is done, the rules above given for determining

---

[*] Institution of Mechanical Engineers. First Report of the Committee on the Hardening, Tempering, and Annealing of Steel, 1879.

[†] "Classement et Emploi des Aciers." Par V. Deshayes, Paris, 1879.

[‡] "Tenth Annual Report" (1879), p. 36.

[§] "Seventh Annual Report" (1876), p. 34.

[*] "Experiments on Wrought Iron and Steel." By David Kirkaldy, page 91.

[†] *Journal of the Iron and Steel Institute* (1879), No. 2, p. 504.

[‡] "Classement et Emploi des Aciers," p. 96.

[§] Uber die Festigkeitsversuche mit Eisen und Stahl. Berlin, 1870.

TENSILE TESTS.

No. of Expt.	Sample of Steel.	Dimensions.		Limit of Elasticity.		Breaking Load.		Ratio of Limit to Breaking Load.	Ultimate Permanent Extension in 10 inches.	Modulus Elasticity. (E.)
		Diameter.	Length.	Pounds per sq. in.	Tons per sq. in.	Pounds per sq. in.	Tons per sq. in.			
		Inch.	Inches.						Per cent.	Pounds per sq. in.
1	B soft	0·694	10	69,200	30·88	126,600	56·50	0·547	4·78	31,350,000
2	B hard	0·700	10	—	—	97,400	43·49	—	About 0·02	30,400,000
3	C soft	0·694	10	55,550	24·80	114,150	50·96	0·487	7·59	29,760,000
4	C hard	0·698	10	138,300	61·76	139,600	62·32	0·991	Just perceptible.	30,860,000
5	D soft	0·694	10	74,200	33·13	141,270	63·06	0·525	3·63	30,960,000
6	D hard	0·701	10	About 92,000	About 41·07	133,700	59·68	0·688	Not visible	30,310,000

COMPRESSIVE TESTS.

No. of Expt.	Sample of Steel.	Dimensions.		Maximum total Load Applied.	Maximum Load per square inch.		Permanent Compression.
		Diameter.	Length.		Pounds.	Tons.	
		Inch.	Inch.	Pounds.			Inch.
7	B hard	0·698	0·701	100,000	261,100	116·57	0·020
8	C hard	0·700	0·700	100,000	259,700	115·96	0·002
9	D hard	0·702	0·703	100,000	258,400	115·36	0·002

resistance to impact in all probability become less applicable.

With a view to ascertain the mechanical properties which characterise a good die-steel, samples have been submitted to Professor Kennedy, Memb. Inst. C.E., of University College, London, for trial in the special machines employed for testing metals. These samples are indicated by the letters B, C, and D, and are identical with those marked by the same letters in the preceding table of analyses. The results are given in the accompanying tables.

All the specimens of metal, except those used for experiments 1, 3, and 5, were hardened in the same manner and to the same degree as a die, in order that the results obtained might as far as possible be applicable to the metal as used in the Mint. On comparing them, it will be seen that the three qualities are marked by well-defined characteristics, which are in certain cases very unusual. Thus, the breaking load commonly increases on hardening, as in the case of C, but B, and to a less extent D, show a distinct fall, and this result, it should be observed, has been confirmed by duplicate experiments, and is in accordance with the results of certain experiments by Kirkaldy. The high value of Åkerman's criterion, the ratio of the Limit of Elasticity to Breaking Load, in experiment 4, would imply that this steel, although well able to resist impact when soft, is exceptionally bad when hard. The information afforded by the experiments on compression is for the most part of a negative character, as the application of the full load of the machine did not produce any marked impression.

Viewing these mechanical tests in the light of the chemical composition, it is to be observed that C contains 0·28 per cent less carbon, 0·12 per cent more silicon, and 0·12 per cent more manganese than B, and this difference in composition corresponds to a diminution, in the case of the soft specimen of C, of no less than 6 tons per square inch in the breaking load. It may, however, be safely asserted that both the chemical composition of sample C and its mechanical properties prove it to be a good variety of steel, although it appears to be more severely tried than B by the operation of hardening as practised in the Mint. In the case of sample D, the evidence of unsuitability afforded by the chemical and mechanical tests is more apparent, and it has been found to be quite incapable of standing the ordinary method of hardening.

It is as yet impossible to say which of the three varieties of steel (B, C, and D) under consideration would, with treatment that is in every way suitable to it, produce the most perfect die. Unfortunately the sample A, that struck 200,000 florins, being a finished die, could not be tested mechanically; the chemical analysis, however, indicates that it would stand cold water hardening even better than B. There can be no doubt that plunging red-hot steel into cold water severely strains the metal, and the investigation generally (so far as it has been carried) shows the special importance of studying the influence of hardening in the manufacture of dies. I have already made some experiments in this direction, and the results will be communicated to a Committee, of which I am a member, appointed by the Institute of Mechanical Engineers to inquire into the phenomena of Hardening, Tempering, and Annealing of steel.

ON THE
ACTION OF POTASSIUM NITRITE ON AMMONIUM CHLORIDE.

By Dr. D. TOMMASI.

It has long been known that when a solution of potassium nitrite and ammonium chloride is heated, water and nitrogen are formed. But if a mixture of dry potassium nitrite and dry ammonium chloride is heated, such is not the case. The products of this reaction are very complex, and their nature depends on the quantity of the salt used, and particularly on the temperature to which the mixture is heated.

At present I cannot enter into any details on this subject. I only wish to describe in this note a very curious experiment that I have had occasion to make during this research.

If 10 grms. of potassium nitrite are melted in a porcelain crucible, and then a small quantity of ammonium chloride be added, we notice that this salt commences to rotate with a variable velocity, and then takes fire and burns with a violet-purple flame, accompanied by a feeble detonation, in fact it behaves exactly like a globule of potassium burning on water. With ammonium sulphate the phenomenon is more striking, but only very small quantities should be used, or the experiment will become dangerous on account of the projections. The products of the reaction between potassium nitrite and ammonium chloride are: Potassium chloride, ammonia, nitrous fumes, and probably nitrogen as well. Ammonium sulphate and potassium nitrite give the same products, except, of course, potassium sulphate instead of potassium chloride. Ammonium nitrate, when in contact with melted potassium nitrite, produces a remarkable luminous phenomenon. If the ammonium nitrate is in small crystals, a series of phosphorescent points are formed, but if, on the contrary, one crystal, however small, be introduced, it forms a globule surrounded by a phosphorescent ring, and it rotates with great rapidity, and then suddenly explodes, producing a beautiful flame.

At present I am occupied in examining the nature of the gases which are evolved by the actions of ammonium chloride, sulphate, and nitrate, on potassium nitrite, and when these analyses are finished I shall endeavour to give an explanation of the reactions of which I have spoken.

RELATIONS BETWEEN THE ATOMIC WEIGHTS OF THE ELEMENTS.

By M. MAXIMILIEN GERBER.

We know the celebrated hypothesis of Prout, according to which the atomic weights of the elements are exact multiples of the weight of the atom of hydrogen = 1. The determinations of atomic weights executed by Berzelius, Dumas, and especially Marignac and Stas, have shown that this hypothesis must be abandoned, or at least that it cannot be maintained in its original form.

Thanks to the experimental precision and to the rigour of the methods employed by these chemists, we know now, within a few hundredths, the exact value of about 30 atomic weights. On considering these values we see that they have no common divisor; such a divisor, if existing, could be merely a very small fraction of unity, and for the present would entirely escape experimental verification.

The case is different when, in place of considering the totality of the atomic weights, we compare together the weights of such bodies as form a natural group. Several authors, Dumas being the first, have pointed out more or less close relations between the atomic weights of the elements of one and the same family; for instance, between O, S, Se, Te, — Mg, Ca, Sr, Ba, &c.

I have endeavoured to generalise this fact. On dividing the simple bodies now known into four great classes, characterised by the predominant atomicity of the elements which they include, I find for each of these classes a common divisor, greater than unity, or approaching it very closely. Thus, the atomic weights of the bodies of one and the same class are found to be exact multiples of this common divisor by simple and entire factors.

The first of these classes contains the so-called mono-atomic elements, *i.e.*, the alkaline metals which combine with oxygen according to the type R_2O, and with chlorine, RCl; as also the non-metallic halogens, fluorine, chlorine, bromine, iodine.

The second class comprises the elements which are distinctly di- or tetratomic, *i.e.*, on the one hand, the alkaline-earthy metals (RO), and on the other, the non-metallic elements of the family of oxygen and carbon.

In the third class I arrange the elements which act most generally as tri- or penta-valent; nitrogen, boron, &c. The type of their most stable oxide is R_2O_3, and their chlorides are RCl_3 or RCl_5.

The fourth class, lastly, which is by far the most common, comprises the metals properly so-called which present the types of oxygenation RO and R_2O_3.

The following tables will show this fact clearly:—

Mono-atomic Elements, Electro-Positive or Electro-Negative.

Common factor : D = 0·769.

			Atomic Weights.
Lithium ..	3×3D =	9D = 6·921	Li = 7·01
Sodium ..	10×3D =	30D = 23·07	Na = 23·04
Potassium ..	17×3D =	51D = 39·219	K = 39·1
Rubidium ..	37×3D =	111D = 85·359	Rb = 85·2
Cæsium ..		= 172D = 132·268	Cs = 132·2
Fluorine ..	.. ..	25D = 19·225	Fl = 19·1
Chlorine ..	.. ..	46D = 35·354	Cl = 35·37
Bromine ..	.. ..	104D = 79·976	Br = 79·9
Iodine ..	.. ..	165D = 126·885	I = 126·7

Appendix.

Hydrogen ..	.. ..	13/10D = 0·9997	H = 1
Silver ..	.. ..	140D = 107·66	Ag = 107·66

D = 1·995.

Oxygen ..	1×8D =	8D = 15·96	O = 15·96
Sulphur ..	2×8D =	16D = 31·92	S = 31·98
Selenium ..	5×8D =	40D = 79·80	Se = 79 to 79·46 ?
Tellurium ..	8×8D =	64D = 127·68	Te = 127·8
Magnesium	3×4D =	12D = 23·94	Mg = 23·94
Calcium ..	5×4D =	20D = 39·90	Ca = 39·9
Strontium ..	11×4D =	44D = 87·78	Sr = 87·2 ?
Barium ..		69D = 137·665	Br = 137·0
Carbon ..		6D = 11·97	C = 11·97
Silicon ..		14D = 27·93	Si = 28
Titanium ..		25D = 49·875	Ti = 50 ?
Zirconium ..		45D = 89·775	Zr = 90 ?
Tin		59D = 117·705	Sn = 117·8

Appendix.

Mercury ..	100D = 199·5	Hg = 199·8
Molybdenum	48D = 95·76	Mo = 95·8
Tungsten ..	92D = 183·54	W = 184
Uranium ..	60D = 119·7	U = 120

Third Class.

D = 1·559.

Nitrogen ..	9D = 14·031	N = 14·01
Phosphorus	20D = 31·18	P = 31 ?
Arsenic ..	48D = 74·83	As = 74·9
Antimony ..	71D = 120·04	Sb = 120
Bismuth ..	135D = 210·405	Bi = 210 ?

Appendix.

Gold	126D = 196·434	Au = 196·3

Fourth Class.

D = 1·245.

Glucinum ..	11D = 13·695	G = 13·65
Aluminium	22D = 27·390	Al = 27·4
Scandium ..	36D = 43·575	Sc = 44 ?
Chromium ..	42D = 52·290	Cr = 52·3 to 52·4
Iron	45D = 56·025	Fe = 55·9
Gallium ..	56D = 69·720	Ga = 69·8
Indium ..	91D = 113·295	In = 113·4
Zinc	52D = 64·740	Zn = 64·9
Cadmium ..	90D = 112·050	Cd = 111·6 ?
Manganese	44D = 54·780	Mn = 54·8
Nickel ..	47D = 58·515	Ni = 58 to 59 ?
Cobalt ..	48D = 59·760	Co = 59 to 60 ?

		Atomic Weights.
Copper ..	51D = 63·495	Cu = 63·5
Lead	166D = 206·670	Pb = 206·4
Thallium ..	164D = 204·18	Tl = 203·6 ?
Ruthenium	83D = 103·335	Ru = 103·5 ?
Rhodium ..	84D = 104·580	R = 104·2 ?
Palladium ..	85D = 105·825	Pd = 106·2 ?
Iridium ..	158D = 196·710	Ir = 196·7 ?
Platinum ..	159D = 197·955	Pt = 196·7 to 199 ?
Osmium ..	160D = 199·2	Os = 198·6 to 199·2 ?
Yttrium ..		Yt = 89·6 to 92·5 ?
Cerium ..	110D = 136·95	Ce = 137 ?
Lanthanum	112D = 139·440	La = 139 ?
Didymium ..	118D = 146·910	Di = 147 ?
Erbium ..		Er = 162 to 170·6 ?
Thorium ..	184D = 234·060	Th = 233·9 to 234 ?

What importance should be attached to these numerical relations? We may remark at first that the common factors which I make use of have been determined empirically, and that no simple relation exists among them. They have therefore no value in themselves.

If, on the one hand, it is remarkable to find very simple relations for certain well-characterised groups, *e.g.*, O, S, Se, Te; Li, K, Na, Rb, &c., on the other hand there are groups of elements like Cl, Br, I, which present much more complex relations. There is also a great difficulty as regards the elements which may belong to two different series; like Mn, which may be assimilated to the halogens (on account of $Mn_2O_8K_2$), and Zn, which may approximate to Mg, &c.

It seems to me, nevertheless, that the relations which I point out would deserve attention if more precise determinations of the atomic weights should confirm their generality. We might then see in them a method of checking theoretically the atomic weight of each element. But at present we have not advanced so far, and the interest of this classification is contestable.

I wish, nevertheless, to adduce two facts of a kind to give some weight to my views, and which have determined me to publish them in their imperfect state. These are the facts:—

The atomic weights of the rare elements selenium and tellurium may be regarded as not very accurately known. M. Mendeleeff has especially raised doubts on the accuracy of that assigned to tellurium (128·02 according to Berzelius, and 129 according to Dumas). M. Mendeleeff considers these values too high. In the list of the elements arranged in the order of their increasing atomic weights, tellurium ought to rank before iodine, and consequently should have an atomic weight inferior to I = 126·7. To remove this doubt M. W. L. Will has re-determined this contested atomic weight. His analyses lead to the following values:—Te = 127·80, 127·99, 127·74, or a mean of 127·84, O being = 15·96; whilst, according to my system, we should have Te + 127·68. The difference is quite within the limit of errors of observation, in case of such high atomic weights.

The second fact is as follows:—Since the researches of Awdeeff, glucinum has been classed with the diatomic alkaline earthy metals, forming an oxide GO with $G'' = 9{\cdot}3$. The specific heat of the metal as determined by Reynolds seemed to confirm this view, and in the classification of Mendeleeff glucinum = 9·3 finds its place between lithium = 7·02 and boron = 11. The recent researches of MM. Nilson and Pettersson on the compounds of glucinum have somewhat modified the *equivalent* of this element. These authors find it = 4·55. But they have shown that in accordance with chemical analogies and the characters of metallic glucinum, it is requisite to revert to the old formula of the oxide glucina as proposed by Berzelius, G_2O_3. Hence the atomic weight becomes = 13·65. This result was in a manner indicated by my attempt at classification. With the atomic weight 9·3, or even 9·1, it is impossible for me to class glucinum with the alkaline earthy metals. But it ranks naturally along with aluminium with an atomic weight, which agrees with that assigned by the researches of MM. Nilson and Pettersson.—*Les Mondes.*

BRITISH ASSOCIATION.

THE following arrangements have been made for the fifty-first meeting of the British Association, to be held at York:—The first general meeting will be held on Wednesday, August 31, at 8 p.m. precisely, when A. C. Ramsay, F.R.S., will resign the chair, and Sir John Lubbock, Bart., F.R.S., President-Elect, will assume the presidency, and deliver an address. On Friday evening, September 2, a discourse by Prof. Huxley, Sec. R.S.; on Monday evening, September 5, a discourse by W. Spottiswoode, President of the Royal Society.

The general officers are—General Secretaries: Capt. Douglas Galton, F.R.S.; Philip Lutley Sclater, Ph.D., F.R.S. Acting Secretary: George Griffith, F.C.S., Harrow. General Treasurer: Prof. Williamson, F.R.S. Local Secretaries: Rev. Thomas Adams; Tempest Anderson, M.D., B.Sc., York.

The sections are arranged as follows:—

A. *Mathematical and Physical Science.*—President: Prof. Sir William Thomson, F.R.S.

B. *Chemical Science.*—President: Prof. Williamson, For. Sec. R.S.

C. *Geology.*—President: Andrew Crombie Ramsay, LL.D., F.R.S.

D. *Biology.*—President: Richard Owen, F.R.S. Secretaries: G. W. Bloxam, M.A., F.L.S.; W. L. Distant; W. A. Forbes, F.Z.S.; Prof. M'Nab, M.D.; John Priestley; and Howard Saunders, F.L.S., F.Z.S. *Department of Zoology and Botany.*—Richard Owen, F.R.S., will preside. Secretaries: Prof. M'Nab, M.D. (Recorder), and Howard Saunders, F.L.S., F.Z.S. *Department of Anthropology.*—Prof. W. H. Flower, F.R.S., will preside. Secretaries: G. W. Bloxam, M.A., F.L.S. (Recorder), and W. L. Distant. *Department of Anatomy and Physiology.*—Prof. J. S. Burdon Sanderson, F.R.S., will preside. Secretaries: John Priestley (Recorder), and W. A. Forbes, F.Z.S.

E. *Geography.*—President: Sir J. D. Hooker, K.C.S.I., C.B., F.R.S. Secretaries: H. W. Bates, Assist.-Sec. R.G.S., F.L.S., and E. C. Rye, Librarian R.G.S., F.Z.S. (Recorder).

G. *Mechanical Science.*—President: Sir W. G. Armstrong, C.B., F.R.S.

Tickets for the meeting may be obtained of the Local Secretaries at York, and at the office of the Association, 22, Albemarle Street, London, W.; or on application by letter, from August 17 to August 24, to the General Treasurer, Prof. A. W. Williamson, British Association, University College, London, W.C.

Influence of the Concentration of the Liquids upon the Electro-motive Force of a Daniell's Element.—J. V. Hepperger.—The current proceeds invariably from the more to the less dense solution. The electro-motive force of a 1 per cent solution of zinc-sulphate as compared with one of 10, 20, 30, 40, 50, 60 per cent. and one saturated is as 11, 18, 21, 25, 31, 37, 41. The electro-motive force of a 1 per cent solution of copper sulphate as against those of 5, 10, 15, 20, 25, 30 and a saturated one is as 13, 18, 21, 24, 26, 27, 29.—*Wiener Anzeiger.*

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, May 19, 1881.

Prof. H. E. Roscoe, President, in the Chair.

The following certificates were read for the first time:—H. Frankland, A. J. Hailes, J. P. Wilkes.

The following papers were read:—"*On Ammonium Nitrite and the Reaction between Hydrogen and Nitric Oxide in the Presence of Spongy Platinum*," by L. T. Wright. The author has been engaged in studying the reaction between ammonium chloride and potassium nitrite when a solution of these substances is boiled. He finds that free ammonia and ammonium nitrite are always present in the distillate, and that the equation is much more complicated than that usually given,—

$$NH_4Cl+KNO_2=N_2+KCl+2H_2O.$$

Further quantitative work on this reaction is promised. The author then repeated the experiments of G. S. Johnson (*Chem. Soc. Journ.*, March, 1881) "On the Synthesis of Ammonia from Nitrogen and Hydrogen in the Presence of Spongy Platinum." He has been quite unable to confirm Mr. Johnson's results. When hydrogen and nitrogen (3 : 1) were passed through spongy platinum, small quantities of ammonia were always formed, but the nitrogen always contained traces of nitric oxide, recognised by the odour of nitrous acid when mixed with air, and the discolouration of iodide of potassium and starch papers. The author found that the ferrous sulphate solution did not absorb the nitric oxide completely, and, as is well known, nitric oxide and hydrogen form ammonia when passed over spongy platinum. When nitrogen from the action of potassium hypobromite and ammonium chloride was used, instead of the nitrogen from ammonium nitrite, no ammonia was formed in the above experiment. Also, by passing the nitrogen evolved by boiling potassium nitrite and ammonium chloride through absorption tubes charged with an alkaline solution of sodium sulphite, instead of ferrous sulphate, the nitric oxide was decomposed, and in one experiment lasting an hour, only 0·003 milligrm. of NH_3 was produced, and in a second none. The author draws the following conclusions:—That nitric oxide is not completely absorbed by ferrous sulphate at ordinary temperatures; that hydrogen reacts upon nitric oxide to form ammonia in the presence of cold spongy platinum when the hydrogen is in sufficient excess; that with nitrous oxide no such reaction takes place; that nitrogen and hydrogen do not synthetically combine to produce ammonia in the presence of spongy platinum, at least, when the nitrogen is produced by the decomposition of ammonium nitrite.

Mr. Johnson said that practically the author confirmed his result that when nitrogen purified by passing through ferrous sulphate was passed with hydrogen over spongy platinum, ammonia was formed. He begged to dissent, however, from the author's conclusion that the nitrogen employed by himself contained NO. The gas which he used had been passed for a whole hour over heated finely-divided copper without altering its weight. It was therefore quite free from NO.

Mr. Warington suggested that the question as to whether the gas contained NO or not might be set at rest by adding oxygen to the nitrogen, and passing the mixture into potassium iodide.

A short discussion then ensued, in which Dr. Tidy, Messrs. J. M. Thomson, Johnson, Wright, Thorp, and Warington took part, as to the decomposition of nitric oxide by heated metallic copper; the general opinion seemed to be that under certain circumstances traces of NO might escape decomposition although passed over several inches of heated copper.

Mr. J. M. Thomson then communicated a paper "*On the Synthetical Production of Urea from Benzol, Ammonia, and Air by the Action of Heated Platinum*," by E. F. Herroun. The author has aspirated air through benzol and ammonia, and then passed the mixed vapours over heated platinum wire. Urea was formed mixed with ammonium carbonate and sulphate and some substance of a resinous nature, soluble in ether. The urea was purified and agreed in its reactions and composition with ordinary urea. Spongy platinum and platinised asbestos and charcoal were substituted for the wire, but no urea was formed; also when olefiant gas was used instead of benzol vapour, no urea was produced. Acetylen, on the other hand, behaved in a similar way to benzol, and a considerable yield of urea was obtained.

"*On a Proposed Volumetric Method for the ready Estimation of a Soluble Sulphite and Free Sulphurous Acid, or of Free Sulphurous and Sulphuric Acids, even in the Presence of Sulphates*," by O. V. Pisani. This proposed method is based on the following two equations:—

(1.) $M''SO_3+I_2+H_2O=M''SO_4+2HI.$

(2.) $SO_2+I_2+2H_2O=H_2SO_4+2HI.$

By (1) it is seen that one molecular weight of a sulphite yields two molecules of hydriodic acid, and by (2) that free sulphur dioxide yields in addition one molecule of free sulphuric acid. The author proposes to estimate the iodine used, and the soda required to neutralise the fluid after the addition of the iodine, and from these data estimate the free and combined sulphurous acid. To estimate the sulphates, all the sulphur is oxidised by chlorine, and the sulphates produced from the sulphites deducted. The author has apparently not tested the practical working of the process, and no experiments are given in the paper which he submits to the criticism of the Society.

"*On the Identification of Crystallised Alkaloids, &c., by the Microscope and the Use of Polarised Light*," by A. Percy Smith. The author states that the use of the microscope in chemical analysis is usually ignored in text-books not specially devoted to microscopic research, and that he has found the advantage of an optical examination in determining the purity of a crystalline salt. He has used polarised light with selenite plate in the ordinary way. The paper is accompanied with careful drawings of crystals of strychnin, santonin, brucin sulphate, cantharidin, &c. In most cases this mode of identification only applies to pure alkaloids or their salts, any admixture with other crystallisable bodies proving fatal. The author has, however, recognised cantharidin in a mixture of twenty-five alkaloids, and identified strychnin, cantharidin, santonin, opium, and laburnum in a mixture of lentil soup, bread, meat, and cheese.

Prof. Tidy said that he had some experience in this subject, and that in most cases the microscope was of little use in identifying the alkaloids by their crystalline form, as a trace of some other substance sometimes altered the appearance enormously. Thus a trace of piperin would completely alter the crystalline form of strychnin.

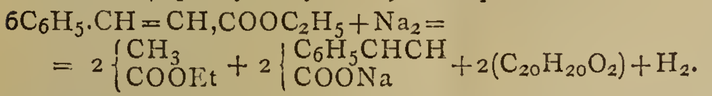
"*On the Colour-properties and Colour-reactions of the Metals of the Iron-copper Group*," by T. Bayley. The author continues in this paper his previous investigations as to the quantities of cobalt and nickel, or cobalt, copper, and iron, as sulphates, which when mixed produce colourless grey solutions. Thus at 5° C. a mixture of 1 part of copper, and 1½ parts of iron simulates a solution of nickel sulphate, at 15° C. equal parts of iron and copper are required. The two following mixtures are chromatically neutral:—20 parts copper, 7 iron, 6 cobalt; and 13 copper, 8·75 nickel, 6 cobalt, so that 8·75 parts of nickel are equal as regards quality of colour to 7 parts of iron + 7 parts of copper. These colourless opaque solutions in sufficient thickness transmit no light, and the light transmitted by solutions of less thickness is compound white light made up of the rays of two complementary beams, one having its centre in the yellow and the other in the indigo.

Under certain circumstances described in the paper, nickel forms yellow, copper forms copper-red, and cobalt forms orange solutions.

"*On the Effects of the Growth of Plants on the amount of Matter Removed from the Soil by Rain*," by E. W. Prevost. The experiments were carried on in large glazed stoneware pans, 18″ in diameter, 10″ deep, each containing 100 lbs. of soil, and provided with arrangements for collecting the drainage water. Analyses of the soil, drainage water, composition of the ash of the plants, &c., are given in elaborate tables. The plants grown included cabbage, wheat, beans, clover, and turnips.

The President, in asking for any remarks on the paper, took the opportunity to express his regret that the authors of communications were not more frequently present, as it was almost impossible to grasp the salient points of a paper on hearing it read for the first time.

"*On the Action of Sodium on Cinnamic Ether*," by F. Hatton. This paper is a continuation of some previous work of Dr. Hodgkinson's. The author has studied the reaction, and concludes that it is probably represented in the case of β-phenyl-acrylate by the equation—



$$6C_6H_5.CH=CH,COOC_2H_5+Na_2= \\ = 2\left\{\begin{matrix}CH_3\\COOEt\end{matrix}\right. + 2\left|\begin{matrix}C_6H_5CHCH\\COONa\end{matrix}\right. + 2(C_{20}H_{20}O_2)+H_2.$$

The substance $C_{20}H_{20}O_2$ decomposes partially on distillation. The action of ethylic β-phenyl-propionate is similar.

The Society then adjourned to June 2, when the following papers will be read:—"On Isomeric Acids Obtained from the Ethers of the Hydride of Salicyl and from Coumarins," by W. H. Perkin; "On the Saponification of Fatty Oils and Waxes," by A. H. Allen and W. Thomson; "On the Sulphides of Copper and a Determination of their Molecular Weights," by S. Pickering.

ROYAL INSTITUTION OF GREAT BRITAIN.

Friday, March 4, 1881.

William Bowman, Esq., F.R.S., Vice-President in the Chair.

"*Elasticity Viewed as Possibly a Mode of Motion.*" By Sir William Thomson, LL.D., F.R.S., &c.

With reference to the title of his discourse the speaker said: "The mere title of Dr. Tyndall's beautiful book, 'Heat, a Mode of Motion,' is a lesson of truth which has manifested far and wide through the world one of the greatest discoveries of modern philosophy. I have always admired it; I have long coveted it for Elasticity; and now, by kind permission of its inventor, I have borrowed it for this evening's discourse.

"A century and a half ago, Daniel Bernouilli shadowed forth the kinetic theory of the elasticity of gases, which has been accepted as truth by Joule, splendidly developed by Clausius and Maxwell, raised from statistics of the swayings of a crowd to observation and measurement of the free path of an individual atom in Tait and Dewar's explanation of Crookes's grand discovery of the radiometer, and in the vivid realisation of the old Lucretian torrents with which Crookes himself has followed up their explanation of his own earlier experiments; by which, less than two hundred years after its first discovery by Robert Boyle, 'the Spring of Air' is ascertained to be a mere statistical resultant of myriads of molecular collisions.

"But the molecules or atoms must have elasticity, and *this* elasticity must be explained by motion before the uncertain sound given forth in the title of the discourse, 'Elasticity Viewed as Possibly a Mode of Motion,' can be raised to the glorions certainty of 'Heat, a Mode of Motion.'"

The speaker referred to spinning tops, the child's rolling hoop, and the bicycle in rapid motion as cases of stiff, elastic-like firmness produced by motion; and showed experiments with gyrostats in which upright positions, utterly unstable without rotation, were maintained with a firmness, strength, and elasticity as might be produced by bands of steel. A flexible endless chain seemed rigid when caused to run rapidly round a pulley, and when caused to jump off the pulley, and let fall to the floor, stood stiffly upright for a time till its motion was lost by impact and friction of its links on the floor. A limp disc of india-rubber caused to rotate rapidly seemed to acquire the stiffness of a gigantic Rubens' hat-brim. A little wooden ball which when thrust down under still water jumped up again in a moment, remained down as if embedded in jelly when the water was caused to rotate rapidly, and sprang back as if the water had elasticity like that of jelly when it was struck by a stiff wire pushed down through the centre of the cork by which the glass vessel containing the water was filled. Lastly, large smoke rings discharged from a circular or elliptic aperture in a box were shown, by aid of the electric light, in their progress through the air of the theatre when undisturbed. Each ring was circular, and its motion was steady when the aperture from which it proceeded was circular, and when it was not disturbed by another ring. When one ring was sent obliquely after another the collision or approach to collision sent the two away in greatly changed directions, and each vibrating seemingly like an india-rubber band. When the aperture was elliptic each undisturbed ring was seen to be in a state of regular vibration from the beginning, and to continue so throughout its course across the lecture-room. Here, then, in water and air was elasticity as of an elastic solid, developed by mere motion. May not the elasticity of every ultimate atom of matter be thus explained? But this kinetic theory of matter is a dream, and can be nothing else, until it can explain chemical affinity, electricity, magnetism, gravitation, and the inertia of masses (that is, crowds of vortices).

Le Sage's theory might easily give an explanation of gravity and of it relation *to inertia of masses*, on the vortex theory, were it not for the essential aeolotropy of crystals, and the seemingly perfect isotropy of gravity. No finger-post pointing towards a way that can possibly lead to a surmounting of this difficulty, or a turning of its flank, has been discovered, or imagined as discoverable. Belief that no other theory of matter is possible is the only ground for anticipating that there is in store for the world another beautiful book to be called "Elasticity, a Mode of Motion."

SOCIETY OF MEDICAL OFFICERS OF HEALTH.

The Committee appointed to consider—

1. The best and most convenient method of dealing with animal and vegetable trade refuse (*e.g.*, from slaughterhouses, fishmongers', poulterers', greengrocers' shops, &c.), with a view to its collection, removal, and ultimate disposal, whether by utilisation or otherwise;
2. The collection and disposal of house refuse; and
3. The collection and disposal of stable and cowshed refuse,

beg to report as follows:—

1. *With respect to trade refuse.* The Metropolis Local Management Act (18 & 19 Vict., cap. 120, sect. 128) entitles the owner or occupier of any house or land to require the "scavenger" to remove the refuse of any trade, manufacture, or business, &c., on payment of a reasanable sum by way of compensation; but the Nuisance Authority, which by its own staff or by its "contractor" is the "scavenger" has at present no power to remove trade refuse, whatever its nature or condition, excepting on the requisition of the owner or occupier as aforesaid. The committee, however, are of opinion that as the refuse of slaughter-houses and the refuse of the trades of fishmonger, poulterer, greengrocer, &c., being of animal or vegetable origin and liable to decomposition, would, if not speedily removed from the premises, become a "nuisance and injurious to health,'

the Nuisance Authority should have power as well as obligation to collect, remove, and dispose of such refuse, and should receive reasonable compensation for so doing.

In the City of London, the Nuisance Authority (Commissioners of Sewers), as a matter of fact collect trade refuse—animal and vegetable—receiving payment; and the Committee are informed by the Medical Officer of Health, that the Commissioners have under consideration a scheme for its profitable utilisation—a scheme which is the more likely to succeed as the Commissioners will have to deal with large and regular supplies. It is open to question whether the Nuisance Authority in a district not having public markets could profitably utilise limited quantities of animal refuse directly; but possibly a scheme might be arranged for this purpose through the agency of establishments where "offensive trades" are carried on under the provisions of the Slaughter-houses Metropolis Act, 1874.

In any case the refuse should be collected daily in the early morning hours, and conveyed in properly constructed covered receptacles or in vehicles expressly adapted for the prevention of effluvium nuisance. Failing an arrangement for utilisation, each district should provide the means of destroying animal refuse. It appears doubtful whether vegetable refuse could be profitably utilised in London by the process of "carbonisation." The mere destruction of such refuse by fire could be effected without difficulty or nuisance.

2. *With respect to the Collection and Disposal of House Refuse.*—It is almost superfluous to observe that the Committee cannot approve of the refuse being deposited in large heaps or "tips" in or near towns or inhabited dwellings: its use for levelling land for building purposes is now very properly forbidden by the bye-laws regulating the foundations of buildings,* and its destruction in the open air, creating an intolerable nuisance, is impracticable.

The refuse, moreover, is not without value—the "breeze," for instance, being almost indispensable to the brickmaker. The value, however, has decreased of late years, for the growth of London has led to the production of the refuse in larger amount, while the increased distance to the brickfields has greatly increased the cost of carriage.

Formerly contractors were willing to pay large sums for the privilege of removing the contents of dust-bins. Now they invariably receive payment. The expense to the Nuisance Authority, however, is not so great as it would be were not the refuse capable of utilisation for various trade purposes. Of these the manufacture of bricks is the most important; and it is, perhaps, not too much to say that the diligence of the contractor in carrying out his contract is governed to no inconsiderable extent by the season of the year and by the demands of the brickmaker, so that the dust-bins are apt to be neglected when their contents are not in requisition in the brickfield.

The Committee consider, however, that the removal of house refuse ought not to depend upon its pecuniary value, but should be regarded from the sanitary rather than the commercial point of view, and they are of opinion that the time is at hand when the Nuisance Authority will have to adopt the process of refuse-destruction by fire, in specially constructed apparatus, such for instance as is in operation at many great provincial centres of population, as Birmingham, Leeds, Manchester, Warrington, &c., &c. The mere reduction in bulk resulting from this process (some 70 to 80 per cent) is in itself a great gain, so that in the event of no practicable means of utilising the products of combustion—slag and dust—being found, the quantity of perfectly innocuous matter to be disposed of would be relatively small. This is a very important factor in the cost, having regard to the limited facilities for water carriage, and to the exorbitant, not to say prohibitory, cost of railway carriage. The slag, however, is useful for making up roads; and ground into powder and mixed with lime it makes a valuable mortar, which in the provincial towns finds a ready sale at a remunerative price.

The combustion apparatus might be made available for the destruction of vegetable refuse and of infected articles; and probably it would suffice for the destruction of small quantities of animal refuse, failing any scheme for its "utilisation."

3. *With Respect to Stable and Cow-shed Refuse.*—The Nuisance Authority has power under the 53rd section of the Sanitary Act, 1866, to make regulations for the "periodical removal" by the owner, of manure, &c., and an ample penalty, twenty shillings per day, is provided for default. Nevertheless, when regulations exist they are rarely carried out strictly, for this reason among others, that it is found difficult to get Justices to inflict the penalties for neglect or default.

Of late years the difficulty of procuring the removal of the refuse has considerably increased, owing to the growth of London and the greater distances to the fields and market gardens. Formerly stable manure was in request by market gardeners, who paid a good price for it. Now, horse owners generally have to pay for its removal, or at best give it away. It is often difficult, moreover, to get it removed on any terms, for as a rule it is conveyed in vehicles returning from the markets; and at certains seasons of the year, *e.g.*, hay-making and harvest-time, it is practically impossible to get the farmers to send their carts so regularly as is necessary for compliance with the regulations.

"With the permission of the owner" the Nuisance Authosity may collect the refuse: but the Committee are of opinion that the Nuisance Authority should have the same right everywhere as in the City of London* to collect it when the owner is in default, and to charge him with the cost of so doing. There is good ground for believing that many horse owners would be glad to be relieved of the difficulty and responsibility of their position under the "regulations," and would be willing to pay a reasonable compensation to the Nuisance Authority to cover the cost of the removal of the refuse. The penalties for default of compliance with the regulations should be rigorously enforced against persons who fail to come to an arrangement with the Nuisance Authority.

Less difficulty is experienced in enforcing the removal of cow-shed refuse, this being further provided for by regulations framed under the "Dairies, Cow-sheds, and Milkshops Order, 1879;" the Nuisance Authority, moreover, being able to bring pressure to bear on offenders on the occasion of the annual application for the renewal of the cow-shed licence. The cow-keeper being thus compelled to incur the expense of removing his shed refuse regularly, would probably welcome any scheme whereby, without increased outlay, this duty would be taken off his hands by the Nuisance Authority.

The refuse of cowsheds should be removed within specified hours in the early morning, in vehicles specially constructed so as to prevent slopping and effluvium nuisance. It would be found difficult in some districts to remove stable refuse within the same hours, and the necessity for so doing would be less, provided it were found practicable to abolish sunken dung-pits, in which manure rapidly ferments and decomposes, giving rise to intolerable nuisance when the receptacle is emptied, and also in the passage of the cart through the streets. Were the plan universal of employing properly paved and drained receptacles enclosed within iron racks above the surface of the ground, so as to dry the refuse by air currents, its removal might be affected at any period of the day without offence, provided it had not been kept too long in the stable or in the receptacle itself, so as to become rotten and offensive.

The Committee having in the second and third sections dealt with the "collection" of trade and stable refuse,

---

* *Vide* Bye-laws made on Oct. 3rd, 1879, by the Metropolitan Board of Works, under the provisions of the Metropolis Management and Buildings Act, 1878, sec. 16.

* City of London Sewers Act, 1851, 14 and 15 Vic., cap. 91, sec. 8.

have now only to express their conviction that legislation will be found necessary to solve the difficulty attending the ultimate "disposal" of such refuse, viz., by imposing on canal and railway companies the obligation of conveying it from towns in boats and vans, expressly contrived for the avoidance of nuisance and at a rate for carriage which, while fairly remunerative, shall not be oppressive to the ratepayers—power to settle the rate, in case of dispute, to be vested in the railway commissioners or some similar tribunal having an equitable jurisdiction.

(*Signed*) T. ORME DUDFIELD, M.D., *Chairman.*
A. WYNTER BLYTH.
ALFRED CARPENTER, M.D.
SHIRLEY F. MURPHY.
WM. SEDGWICK SAUNDERS, M.D.

April 21, 1881.

CORRESPONDENCE.

ESTIMATION OF FAT IN MILK.

To the Editor of the Chemical News.

SIR,—The inference to be drawn from the observations of those gentlemen who have been good enough to criticise my paper show clearly that the *modus operandi* of the process may vary directly with the ingenuity of the experimenter; and I think it is obvious enough, that whether we pass an elongated platinum dish or boat into the extractor, or attain the same end by the wilful destruction of a common watch-glass, the results are in no wise impaired.
—I am, &c.,

WILLIAM M. HAMLET, F.C.S.

London, May 25, 1881.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, l'Académie des Sciences. No. 16, April 18, 1881.

Action of Heat upon the Ammoniated Bases.—A. W. Hofmann.—On heating the hydroxide of an ammoniated base containing different radicles, it is observed that the methylic groups therein contained separate by preference in the state of tertiary bases, whatever may be the order of succession in the system, whilst another group (ethylic, amylic, &c.) leaves the system in the state of a carbide. Thus the hydroxide of methyl-diethyl-amyl-ammonium obtained by the action of methylic iodide upon diethyl-amylamine, and then treating the iodide obtained with silver oxide, is transformed into methyl-ethyl-amyl-amine and ethylene.

Secondary Battery of M. C. Faure.—E. Reynier.—This battery is derived from that of Planté; its electrodes are of lead, and are plunged into water acidulated with sulphuric acid; but its formation is deeper and more rapid. In the Planté battery the formation is limited by the thickness of the sheets of lead. M. Faure gives quickly to his elements an almost unlimited power of accumulation by covering the electrodes with a layer of spongy lead. The two lead plates of an element are individually covered with red lead, or some other insoluble oxide of lead. They are then enclosed in compartments of felt, kept firmly in their places by lead rivets, and the two electrodes are then placed, the one close to the other, in a receptacle containing acidulated water. The element is then traversed by an electric current, which brings the red lead to the state of peroxide upon the positive electrode, and reduces it to metallic lead upon the negative electrode. When the mass has been electrolysed the couple is formed and charged. When discharged the reduced lead is oxidised, and the peroxide of lead is reduced until the element becomes inert. It is then in condition to receive a new electric charge. A quantity of energy capable of performing the work of one horse-power may thus be stored up for an hour in a Faure's battery of 75 kilos.

Action of Electrolysis upon Toluene.—A. Renard.—From pure toluene the author obtains a brown amorphous deliquescent body possessing all the properties of phenose. If the toluene submitted to electrolysis contains benzine the phenose is accompanied by benzo-glycol.

Chemisches Central-blatt.
Vol. 11. No. 37.

Absorption of Radiant Heat in Gases and Fats.—E. Lecher and J. M. Pernter.—The absorptive power of the bodies examined, belonging to the fatty series, for the radiation of a source of heat at 100° is as follows:—Methylic alcohol, formic acid, carbonic oxide, carbonic acid, chloroform, II. ethylic alcohol, acetic acid, ethylic ether, ethyline, III. butylic alcohol, IV. amylic alcohol. Whilst the absorption in each series is approximately equal it increases rapidly with the proportion of carbon.—*Wiener Anzeiger.*

Theory of the Galvanic Element.—F. Exner.—The author shows that between metals and liquids, where no chemical action takes place, there is no more electric separative power than between two metals. The entire effect of a galvanic element depends exclusively on the chemical action.—*Wiener Anzeiger.*

Double Decomposition in the Absence of Water.—A. Potilitzin.—The author's experiments refer to potassium, sodium, and silver bromides, and dry hydrochloric acid. During the reaction heat becomes latent. The quantities of bromine replaced by chlorine are inversely proportional to the atomic weights of the metals, and run counter to the rule of maximum work.

Action of Aluminium Chloride and Bromide upon Carbon Compounds.—J. Gustavson.—Many compound ethers combine with aluminium chloride and bromide.

MEETINGS FOR THE WEEK.

SATURDAY, 28th.—Physical, 3. "On the Change of State from Solid to Liquid," Prof. Poynting. "Illustrations of Fresnel's Theory," C. J. Woodward.
TUESDAY, 31st.—Civil Engineers, 8.
— Royal Institution, 3 p.m. "Non-Metallic Elements," Prof. Dewar.
THURSDAY, June 2nd.—Royal Institution, 3. "Magnetism," Professor Tyndall.
— Royal Society Club, 6.30.
— Chemical, 8. "On the Saponification of Fatty Acids and Waxes," A. H. Allen and W. Thomson. "On the Sulphides of Copper and a Determination of their Molecular Weight," Spencer Pickering.
FRIDAY, 3rd.—Royal Institution, 8. "Magnetic Disturbance, Auroræ, and Earth Currents," Professor W. G. Adams, 9.
— Geologists' Association, 8.
SATURDAY, 4th.—Royal Institution, 3. "Russian Literature: Gogol," Prof. C. E. Turner.

ERRATUM.—P. 210, col. 2, line 27 from top, *for* 140° C. *read* 104° C.

IRISH HILL BAUXITE (Alum Clay).

THE **IRISH HILL MINING CO.** are now, and always have been, the LARGEST PRODUCERS OF THIS CLAY, of Superior Quality, and supply the Manufacturers of Alum, Sulphate of Alumina, and Alum-Cake, of the United Kingdom, America, and the Continent, almost exclusively.

ANALYSIS BY JOHN PATTINSON, ESQ.

	Dried at 212° F.		
	Gertrude (extra qual.)	1st Quality.	2nd Quality.
Alumina	59·00	53·83	52·00
Peroxide of Iron	0·47	1·57	4·57
Silica	18·00	8·67	12·00
Titanic Acid		5·80	6·20
Lime, Magnesia, Potash, Soda, and Sulphuric Acid	0·23	0·83	1·14
Combined Water	22·30	29·27	24·00
	100·00	99·97	99·91

Our MINES, DRYING KILNS, and GRINDING MILLS are situated very close to the Shipping Ports of BELFAST and LARNE, and adjacent to Railways running alongside both Steamers and Sailing Vessels at both Ports, from either of which shipping is abundant and cheap, therefore we can guarantee Regular Delivery as Buyers require it, and are prepared to quote prices f.o.b. c.i.f., or delivered at any Port, in Bulk or Bags, Lump or Ground.

GEO. G. BLACKWELL, *Managing Director.*

Richmond Buildings, 26, Chapel St.,
Liverpool.

ESTABLISHED 1798.

ROBERT DAGLISH & CO.,

ENGINEERS, BOILER AND BRIDGE MAKERS, MILLWRIGHTS,
BRASS AND IRON FOUNDERS.

Manufacturers of every description of Condensing, or High-pressure Blowing, Pumping, Rolling, Winding, and Patent Steam-engines, of any required power, for Irrigating, Draining, Mining, Rolling Mills, or Water Works purposes, and Manufacturers of every description of Chemical, Colliery, Copper Ore, Gold Mining, Glass, and Rock-salt Machinery.

Black-ash Revolving Furnaces of the Most Approved Type.

Bessemer Steel-Rail Plant.

Compressing-Engines for Collieries, Iron Works, and Weldon's Patent Bleaching-Powder Process.

Caustic, Chlorate, Decomposing, Nitre Nitro-Glycerine, Iodine Potash, Sulphur, Acid, and Oxalic Pans.

Gas Producers Patent for Heating and other Purposes.

Pyrites Burners for Irish, Norwegian, and Spanish Ores of Improved Construction.

Patent Rousing Machinery for Brewers.

Retorts, Acid, Gas, Iodine, Nitric, Nitre Nitro-Glycerine and Vitriol Refining.

Steam Superheaters improved for Oil, Tar, and Resin Refining.

Steam Sulphur Melter.

Stills for Oil, Resin, and Tar.

Wheels, Bevel, Mitre, and Spur Moulded on the Shortest Notice by Patent Machinery.

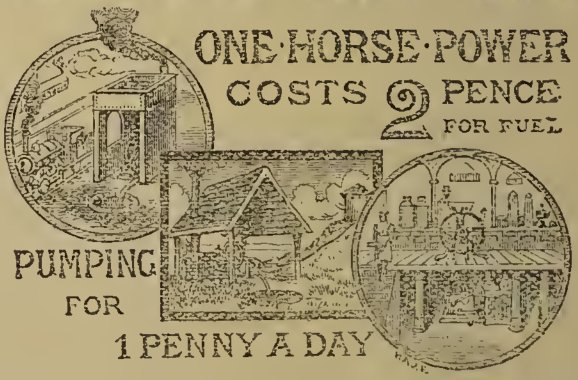
Makers of Mactear's Patent Carbonating Furnace, Jones and Walsh's Patent Sulphate of Soda Furnace, Parnell and Simpson's Patent Causticiser, and Kynaston's Patent Alum Plan

Lists sent on Application.

Photographs, Plans, and other information supplied on receipt of Order.

ST. HELEN'S ENGINE, BOILER, AND BRIDGE WORKS
AND FOUNDRY,
LANCASHIRE.

BAILEY'S PATENT HOT-AIR ENGINE.



Made from ¼ to 5 horse-power. 56lbs. of coke will keep a 1-horse going 12 hours. 1000 galls. of water lifted 50 feet high for a penny.

NO BOILER. NO DANGER.

Awarded Prize Medal by the chief Societies.

SOLE MAKERS—
W. H. BAILEY & Co., Albion Works, Salford, Manchester

THE CHEMICAL NEWS
AND
JOURNAL OF PHYSICAL SCIENCE.

CHARGES FOR ADVERTISEMENTS.

	£	s.	a.
Five lines in column (about 10 words to line)	0	3	6
Each additional line	0	0	6
Whole column	1	15	0
Whole page	3	0	0

A reduction made for a series of insertions.

Cheques and Post-Office Orders, crossed "London and County Bank," payable to the order of William Crookes.

BOY COURT LUDGATE HILL LONDON, E.C.

THE CHEMICAL NEWS.

VOL. XLIII. No. 1123.

EXPERIMENTAL DETERMINATION OF THE VELOCITY OF WHITE AND COLOURED LIGHT.*

By Dr. J. YOUNG, F.R.S., and Professor G. FORBES.

THE method employed in this research to measure the velocity of light resembled the method of M. Fizeau, subsequently employed by M. Cornu. A revolving toothed wheel is employed in the same way to alter the intensity of the light reflected from a distance. In the present method, however, there are two distant reflectors instead of only one. They are separated by a distance of a quarter of a mile. The observing telescope and the two reflectors are almost in the same line. The observer sees two stars of light, which go through their phases with different periods as the toothed wheel is revolved at increasing speeds. One star is increasing, while the other is diminishing, in intensity, with increase of speed of the toothed wheel. The speed required to produce equality of the lights is determined by means of a chronograph.

By choosing such a speed as gives a maximum of one star at the same speed as a minimum of the other, a pair of observations eliminates all cause of doubt arising from varying brightness in the stars, and ratio of the width of a tooth to the width of a space. The distances were observed by triangulation with the Ordnance Survey 18-inch theodolite, using as a base line a side of one of the Ordnance Survey triangles. The source of light was an electric lamp. The velocities (uncorrected for rate of clock, and reduction to a vacuum) measured are as follows:—

187,707
188,405
187,676
186,457
185,788
186,495
187,003
186,190
186,830
187,266
188,110
188,079

Mean .. 187,167 miles a second.

The correction to vacuum is +54 miles a second. The correction for rate of clock to a mean solar time is +52 miles a second.

The final results for the velocity of the light from an electric lamp *in vacuo* is 187,273 miles a second, or 301,382 kilometres a second.

Using Struve's constant of aberration 20·445", we obtain for the solar parallax the value 8·77", and for the mean distance of the sun 93,223,000 miles.

On February 11th, 1881, the reflected stars were seen to be coloured, one reddish, the other bluish. The particular colour of a particular star depended upon the speed of rotation of the toothed wheel. That star which was increasing with increase of speed of the toothed wheel was reddish, that one which was diminishing with increase of speed was bluish. This seems to be caused by the fact that blue rays travels quicker than red rays.

A number of tests were made to judge of the accuracy of this conclusion, and they confirmed it. In the final arrangements, the electric light was acted upon by a bisulphide of carbon prism, and part of a pure spectrum was used. Differential measurements were then made to find the difference in velocity of rotation of the toothed wheel, required to produce equality of red and of blue lights. The most convenient method was to use a driving weight slightly in excess of that required to produce equality of the light, then to fix to the pulley carrying the weights one end of a piece of stout india-rubber tubing, the other end being fixed to a point above. This gradually diminished the effective driving weight. The equality of red lights was first noted, the colour of the light was changed, and the interval of time until the blue lights were equal was measured. The rate at which the india-rubber diminished the speed was afterwards measured by the aid of the chronograph, and thus the difference of speed determined. The mean of 37 determinations in this and other ways gave the result that the difference in velocity between red and blue lights is about 1·8 per cent of the whole velocity, blue travelling most rapidly.

The general conclusion seems to be supported by a comparison of the velocity of light measured by M. Cornu and Mr. Michelson, where the source of light usually employed is taken into consideration. These are the only accurate measurements of the velocity of light hitherto published. They give us the following results:—

	Usual source of Light.	Velocity in kilos, a Second.
Michelson's research..	The sun near horizon	299,940
Cornu's ,, ..	Lime light	300,400
The present ,, ..	Electric light	301,382

Classifying the sources of light used by Cornu, we get the following approximate relative velocities:—

Source of Light.	No. of Observations.	Approximate Relative Velocity.
Petroleum	20	298,776 kilos.
Sun near horizon ..	77	300,242 ,,
Lime light	449	300,290 ,,

All these results seem to support the view that the more refrangible the source of light, the greater is the velocity. But the evidence of the present observations, indicating an excess of velocity for blue over red light, seeming to exceed 1 per cent of the whole, must rest upon the merit of the present observations themselves.

ON THE
ESTIMATION OF PEROXIDE OF HYDROGEN.
(ANSWER TO THE REPLY OF MR. C. T. KINGZETT.)

By EM. SCHÖNE.

MR. KINGZETT has published a "reply" (CHEMICAL NEWS, vol. xliii., p. 161) to my "Remarks" (p. 149) on his "Report on the Atmospheric Oxidation of Phosphorus, &c." (*Jour. Chem. Soc.*, vol. xxxvii., p. 792), on which I, in my turn, will make the following observations:—

I. In his "Report" Mr. Kingzett corrects his error, and agrees with me in saying that *an exactly neutralised solution of peroxide of hydrogen liberates iodine from KI.*

II. Mr. Kingzett, like me, finds (CHEMICAL NEWS, vol. xliii., p. 161) that (in slightly diluted solutions) the quantity of iodine liberated is insignificant in comparison with the quantity of peroxide of hydrogen (*Ibid.*, p. 149) that the solution becomes alkaline, and (*Jour. Chem. Soc.*, vol. xxxvii., p. 792) that the principal portion of peroxide of hydrogen undergoes decomposition into water and free oxygen, viz., undergoes so-called "catalytic" decomposition.*

---

* Abstract of a paper read before the Royal Society, March 19, 1881.

* By "catalytic," for brevity, I mean such a decomposition as, when it ceases, leaves the body, by which it was excited, in its primi-

III. In my detailed treatise in *Liebig's Annalen*, vol. cxcv., p. 228 to 252, I stated that the relative quantity of peroxide which undergoes this "catalytic" decomposition decreases in proportion to the increase of the dilution; and, beginning from a certain limit, we no more perceive the evolution of oxygen, whilst the liberation of iodine continues. When by further dilution the quantity of H_2O_2 in 1 litre becomes less than 1 milligrm., the liberated iodine produces with starch, colourations, the intensity of which decreases with the increase of the dilution.[*] On this last *fact*—not on a supposition, as Mr. Kingzett thinks—is based my colorimetric method of the estimation of peroxide in solutions containing from 0·08 to 1·0 milligrm. H_2O_2 in 1 litre.

IV. In my treatise in *Liebig's Annalen* (vol. cxcv.) I have devoted about five pages (243 to 248) to a detailed explanation of all the facts observed in the mutual action of H_2O_2 and KI in neutral solutions. In my "Remarks" I begged Mr. Kingzett to read my original paper before criticising it. However, from his recent "Reply" it is plain that as yet he has not become acquainted with my detailed treatise, though he continues criticising it. Out of all my explanations of the facts occupying the aforesaid five pages he knows only the four equations which he found in the very short and incomplete abstract in the *Journal of the Chemical Society*, vol. xxxvi., p. 353. At the same time he exclaims—". . . four reactions, supposed by Mr. Schöne to represent the whole truth!" Thus expresses himself a gentleman who has not read what he criticises, and who but a short time ago was not able to distinguish ozone (produced by the slow oxidation of phosphorus) from peroxide of hydrogen. Upon the strength of this I think that I have a right to dispute the competency of my critic, and to protest against such a superficial, unscientific treatment of the serious scientific work of others.

V. It seems to Mr. Kingzett as if the presence of free oxygen in dilute solutions of peroxide of hydrogen—for instance, in atmospheric aqueous precipitation—does not admit an exact determination of peroxide by the colorimetric method offered by me. If, instead of discussing, Mr. Kingzett would make in his laboratory, "with ease and accuracy," a slight experiment he would be easily convinced as to the truth of the fact—which, besides, is well known—that common oxygen (in the dark) has no effect whatever on a solution of neutral potassic iodide (containing starch), consequently that the presence of free oxygen in a solution does not in any case offer a source of error in the determination of peroxide by my method.

VI. Mr. Kingzett presupposes the just-mentioned source of error, because I, in my explanation of the mutual action of KI and H_2O_2 admit, amongst other things, the dissociation of potassic iodide with water—

$$KI+H_2O=HI+KOH$$

(*Liebig's Annalen*, cxcv., 244, and cxciii., 257, in footnotes). He thinks that, if HI had existed in the solution, the oxygen likewise contained in it ought to have set iodine free. Indeed, oxygen decomposes HI in the presence of acids, or of hydriodic acid itself, or some other acid. But in this case a base is present: caustic potash capable of neutralising iodide of hydrogen. And the non-decomposition of iodide of hydrogen by oxygen can be explained by the presence of that alkali. That the presence of these or other substances, especially acids and bases, modifies many reactions there are many examples. I will refer here only to the two following examples relative to the compounds in question:—

Example 1.—Peroxide of hydrogen and peroxide of manganese act on each other differently, in the presence or in the absence of acid.

In the absence of acids peroxide of hydrogen alone is reduced—

$$(MnO_2)+H_2O_2=(MnO_2)+H_2O+O.$$

In the presence of acids peroxide of hydrogen produces a reduction of peroxide of manganese—

$$MnO_2+H_2O_2+H_2SO_4=MnSO_4+O_2+2H_2O.$$

In the presence of a base peroxide of hydrogen, on the contrary, oxidises the manganous oxide and produces peroxide—

$$(KOH)+MnO+H_2O_2=(KOH)+MnO_2+H_2O.$$

Example 2.—Schönbein has shown (*Journal für Praktische Chemie*, lxxxi., 276) that potassic iodide possesses the power of preserving free iodine from the action of the free caustic potash.

Further examples can be found, amongst other things, in the treatises of Lenssen:—"Die Alkalipathischen Oxydationsagentien" (*Ibid.*, lxxxii., 293), and "Die Acidipathschen Oxydationsagentien" (*Ibid.*, lxxxiv., 393).

Thus the fact that free oxygen does not liberate iodine in solutions of neutral potassic iodide does not in the least contradict the dissociation of potassic iodide with water when dissolved in the latter.

VII. Touching what Mr. Kingzett states in his "Reply" in defence of his own method, I find it superfluous to speak about it again. It will suffice to refer to what was said by me relative to that subject in my "Remarks" on his "Report." I will only observe that I do not see any essential difference between Mr. Kingzett's "reasonable large" excess and "ridiculously great" excess of acid, as the experimental ciphers, given by Mr. Kingzett himself, show that the results obtained by both excesses do not essentially differ one from another. In conclusion, concerning the accuracy of the estimation of peroxide of hydrogen by means of the two methods employed by Mr. Kingzett (*Jour. Chem. Soc.*, xxxvii., 807)—namely, "The $KMnO_4$ method" (*without* acid) and "The neutral bichromate method"—I cannot forbear expressing great doubts, having in view, at least, the investigations of Weltzein, Swiontkowski, Aschoff, Brodie, and others about this process.

Petrowskoye Rasumowskoye, near Moscow.
May 5-17, 1881.

---

tive form, not acknowledging, however, by it a catalytic force in the sense used by Berzelius. I cite here the following words from my treatise (*Liebig's Annalen*, 195, 245). "In this case, however, the "catalysis" is incomplete, inasmuch as some of the intermediate products of the decomposition of the substance causing the catalysis, namely, a part of iodine and caustic potash—as the experiment shows —remains."

[†] In diluted solutions the liberation of iodine is produced slowly, in consequence of which the maximum of the colouration is reached only after the lapse of five or six hours.

ON THE
ELIMINATION OF CARBON DISULPHIDE FROM COMMERCIAL BENZOLS BY ALCOHOLIC POTASH.

By BENJAMIN NICKELS.

Since referring to this reaction (see Chemical News, vol. xliii., p. 148) I have received several enquiries for more detailed accounts concerning the precise method of conducting the test, together with limits (if any) of bisulphide removal.

The following examples selected from a great number of trials will serve to afford the information required, and at the same time to illustrate more clearly the details of the operation:—

One of the last experiments made was with a very pure toluol, not having, at the time, benzol of equal purity at disposal; its sp. gr. at 15·5° C. was 0·871, and its boiling-points 109½° to 111° C. 99 c.c. of this toluol and 1 c.c. of carbon bisulphide, equal to 1¼ per cent by weight, were mixed for examination; its sp. gr. was 0·875 at 15·5 C. To this was added 1 grm. of potassium hydrate previously powdered, and dissolved in the smallest quantity of boiling absolute alcohol. On agitating the mixture, it instantly became very yellow, and, at the expiration of about one minute, pasty, from the formation and separation of potassium xanthate, which assumed a highly crystalline and silky appearance, very characteristic of the compound and impossible to be mistaken. The mixture was allowed to digest with occasional shaking during half an hour, at the expiration of which it was filtered. The fluid or toluol portion was then placed in a glass separating funnel, closed with a stopper, and washed by brisk agitation with its own volume of slightly warm water (in order to facilitate the more rapid separation of the toluol under treatment). After allowing to rest for a few minutes, the wash-water containing the alcohol originally present in the mixture together with a little dissolved potassium xanthate, was run off by the glass tap, and the washing operation again repeated with a like quantity of cold water; the toluol was then run off into a dry bottle and agitated with a little plaster-of-Paris to dehydrate, and finally submitted to examination; its sp. gr. was found to be 0·872, or 1° higher than the original toluol, *i.e.*, 0·871, and which showed that the whole of the bisulphide had not been removed by the treatment; the weight of the dried precipitate of xanthate obtained in the experiment also indicated a deficiency, according to the reaction.

$$\underbrace{C_2H_5HO}_{46}+\underbrace{KHO}_{56}+\underbrace{CS_2}_{76}=\underbrace{KC_2H_5COS_2}_{160}+\underbrace{H_2O}_{18}.$$

160 parts of potassium xanthate contain 76 parts of bisulphide, or nearly one-half, and which requires for every one part of bisulphide removed 0·74 part of potassium hydrate. The 1 grm. of that reagent employed in the experiment should have been sufficient to have removed the whole of the bisulphide present, but as the potassium xanthate obtained weighed 1·82 grms. only, it showed 0·91 in place of 1·270=71·6 per cent. The boiling-points on 100 c.c. of the resultant toluol also indicated that it contained a little bisulphide, and which will be observed on comparing the appended figures.

Toluol originally used. Sp. gr., 0·871.		After Alcoholic Potass Treatment. Sp. gr., 0·872.	
At 109·5° C. ..	5 per cent over.	At 107·0° C. ..	5 p.c.
109·6 ..	10 ,, ,,	107·8 ..	10 ,,
109·8 ..	20 ,, ,,	108 8 ..	20 ,,
110 ..	30 ,, ,,	109·8 ..	30 ,,
110·1 ..	40 ,, ,,	110·1 ..	40 ,,
110·2 ..	50 ,, ,,	110·2 ..	50 ,,
110·4 ..	60 ,, ,,	110·4 ..	60 ,,
110·5 ..	70 ,, ,,	110·4 ..	70 ,,
110·6 ..	80 ,, ,,	110·5 ..	80 ,,
110·7 ..	90 ,, ,,	110·6 ..	90 ,,
111·1 ..	95 ,, ,,	111 ..	95 ,,

The presence of bisulphide in the fluid so treated is, I may add, indicated by the heavier sp. gr. and lighter boiling-points noticeable in the first distillates recorded (5 to 30 per cent). The mixture was then subjected to a second treatment with a diminished quantity of potash, 0·5 grm. only in alcoholic solution, and, on agitating, a further colourisation and deposit of xanthate was obtained. At the expiration of half an hour, it was filtered off, washed, and dehydrated as before; its sp. gr. was found to be 0·871, agreeing with the toluol originally taken, and the boiling-points differing only by fractions in the first 15 per cent over.

In order to set the question at rest the fluid was treated a third time with a similar quantity of alcoholic potass, and washed in like manner. No yellow colourisation resulted, nor was potassium xanthate formed, but merely a deposit of amorphous and unaltered potash. This was ultimately filtered off, and, after washing and dehydrating, the toluol showed unaltered sp. gr. and boiling-points, and from which I concluded that the whole of the bisulphide originally introduced within perhaps a minute fraction had been removed.

I may add that in taking the boiling-points I used one of the new fractioning tubes, or "miniature columns," as supplied by Messrs. Townson and Mercer, of Bishopsgate Street, a very marvel of glass-blowing, and a piece of apparatus most effective in benzol fractioning. I have found that 70 per cent at least of the bisulphide and light hydrocarbons contained in ordinary 90 per cent commercial of English make may by its use be concentrated in the first 8 c.c. fractioned out. These instruments I am informed are becoming very much used for the purpose on the Continent. I need hardly say the temperatures were recorded with the bulb of the thermometer immersed in the vapour, and at a distance of about 12 inches from the flask containing the 100 c.c. of fluid under trial, the ordinary method of retort boiling with immersed thermometer being altogether too crude and wide for anything like accurate determinations.

As regards the use of these instruments when substituted for the retort in ordinary benzol boiling, I have not found them of much utility; on the other hand, in fractioning and separating the constituents of a given sample, their performance is perfect. After removal of "bisulphide" by alcoholic potash, the light hydrocarbons, sp. gr. 0·860, are easily separated, and benzol and toluol follow with such facility that no difficulty is experienced in making a fairly complete analysis.

ON THE DETERMINATION OF POTASSIUM AS POTASSIUM PLATINO-CHLORIDE.

By Dr. **ZUCKSCHWERDT** and Dr. **WEST.**

On May 1, 1880, Mr. R. R. Tatlock sent a circular to the potash manufacturers of Germany, in which he describes and recommends his method for the determination of potassium in potash salts. His process is as follows:—

"Dissolve 35 grms. of the sample in water, filter if needful, and dilute to 500 c.c. Put 10 c.c. of the solution in a small porcelain capsule, add 20 c.c. water, stir, and add 30 c.c. of a solution of platinum chloride containing in 100 c.c. 7 grms. platinum. Evaporate in the water-bath, but not to complete dryness, add a few drops of water, evaporate again, treat the precipitate with 2 c.c. of the platinum solution, stirring well; pour on a filter, wash it on the filter with 1 c.c. of the platinum solution, and wash the capsule, the filter, and its contents with a minimum of alcohol at 95 per cent. Dry the filter in the water-bath, bring the precipitate as completely as possible into a small platinum capsule, dry at 100°, and weigh. The filter with adhering traces of the precipitate is incinerated, the residue is weighed, calculated as potassium platino-chloride, and the weight thus obtained is added to quantity of the latter compound already obtained."

At the request of the potassium chloride manufacturers of Leopoldshall and Stassfurt we have examined Tatlock's process closely, and compared it with the method generally used in these works.

The potassium chloride employed in the analyses was found to be perfectly pure by demonstrating the absence of foreign matter. As a further precaution some analyses were made with a potassium chloride specially prepared as follows:—The pure chloride just mentioned was dissolved and mixed with platinum chloride, the liquid, containing excess of platinum chloride, poured off, and chemically pure potassium chloride obtained from the precipitate by ignition, extraction with water, evaporation, and repetition of these processes.

The results according to Tatlock's method were on the average 0·35 per cent too low, whilst those obtained by the method here customary come sufficiently near the truth. The explanation of this deficiency is as follows:—

1. Platinum chloride dissolves potassium platino-

chloride in appreciable quantities: 100 c.c. of a solution of 7 grms. platinum in 100 c.c. dissolved, on agitation for thirty hours on the fly-wheel of a steam-engine, 0·3250 grm. of the double chloride. More concentrated solutions do not dissolve so much; but the error is still so considerable that the first drops of Tatlock's filtrate are rendered turbid by the addition of absolute alcohol, and deposit potassium platino-chloride in microscopic crystals.

2. During the incineration of the filter there is a sensible loss from the evaporation of potassium chloride, depending on the quantity of the precipitate which has adhered to the filter. According to the authors' analysis this loss amounts on an average to 0·1 per cent potassium chloride.

In addition to these two evident sources of error—the magnitude of which Mr. Tatlock seems to admit, otherwise he could not regard a result of 99·5 per cent in chemically pure potassium chloride as admissible—the process has several minor defects which are here mentioned in brief.

1. The measurement of 10 c.c. of a solution of 35 grms. in 500 c.c. is a very difficult task. The loss of one drop (= 1-20th c.c.) gives an error of 0·5 per cent KCl in a salt of 100 per cent. Perhaps it might be prudent, in order to reduce this source of error, to dissolve a smaller weight of the salt in 500 c.c., or to dissolve 35 grms. in a larger vessel, if it is desirable to work with such large quantities. Tatlock dilutes his solution afterwards by the addition of water.

2. Mr. Tatlock pours the contents of the porcelain capsule which has been used for evaporation upon a filter, with the aid first of 2 and then of 1 c.c. platinum chloride, and washes them with alcohol. According to experience here—and probably everywhere—decantation, especially for large quantities of precipitate, is the safer and more rapid method of washing.

3. Tatlock uses an enormous excess of platinum chloride; whilst 0·7 grm. potassium chloride requires only 0·925 grm. of platinum, he takes 2·100, unless we have here a printing fault or an error in calculation. For this he does not give a reason, but it lies probably in the slight solubility of potassium platino-chloride in platinum chloride, since the presence of sodium chloride in a commercial sample cannot justify such an excess. Even 0·7 sodium chloride would only consume 1·180 platinum, or little more than half of prescribed quantity. Why this extravagance in the use of platinum chloride when the object can be attained with alcohol, which is cheaper, and in which all the platinum double salts likely to occur in ordinary analyses are completely soluble? And the use of alcohol after all is not dispensed with!

According to our opinion Tatlock's method gives inaccurate results in consequence of the above-mentioned errors and deficiencies, and should hence be completely rejected.

The method of Fresenius gives perfectly accurate results, but it is too tedious for practice, and we therefore must prefer the method which is in general use in the works of Leopoldshall and Stassfurt, which is as follows:—

10 grms. of a well-mixed sample are dissolved in a 500 c.c. flask, filled up to the mark, shaken, an aliquot part filtered, and 20 c.c. (=0·4 grm.) measured off. This is mixed in a porcelain capsule with 7 c.c. of a solution of platinum chloride containing 10 grs. platinum in 100 c.c.

As commercial samples rarely contain more than 20 per cent sodium chloride, whilst the above quantity of platinum would suffice for 0·4 grm. of sodium chloride at 100 per cent, there is always a considerable excess of platinum chloride present.

The contents of the capsule are then evaporated on the water-bath to the consistence of syrup with frequent stirring, so that when cold the mass appears dry. The free hydrochloric acid is thus chiefly expelled. When cold the mass is covered with 10 c.c. of alcohol at 95 per cent, well rubbed up with a glass rod, and the washings are poured upon a balanced filter. Alcohol is again spirted on, in smaller quantity: the mass is again rubbed up, the washings poured off, and the operation is repeated once more. As a rule, at the second decantation the colour of the washings, and consequently the proportion of the platinum double salt, will be very slight, and in the third operation it disappears altogether; otherwise the operation must be repeated once more. The precipitate, which now consists of perfectly pure potassium platino-chloride, is brought upon the filter by means of the alcohol washing-bottle, and after drying for half an hour at 110° to 115°, it is weighed under the same conditions as it had been when empty.

The total quantity of alcohol consumed is in general 50 c.c. The errors fall within the narrowest limits of permissible experimental errors, and could scarcely be removed or avoided by greater complication.—*Zeitschrift für Analytische Chemie.*

ON THE ATOMIC WEIGHT OF PLATINUM.

By K. SEUBERT.

The irregularities which upon averaging the periodic system have become apparent in that group of the eighth family which includes osmium, iridium, and platinum, render a revision of these atomic weights very desirable. The author has therefore undertaken a re-determination of the atomic weight of platinum.

This weight has hitherto been assumed at about 197, the statements ranging from 196 to 198. The analysis of potassium platino-chloride executed by Berzelius gave, according to the manner of calculation, Pt = 196·705 to 197·234. Andrews, from the relation of total chlorine in the above-mentioned salt to the proportion of metal, found an average value of 197·88. There is also an almost forgotten experiment of Berzelius, in which by reducing platinous chloride he found Pt = 194·177. According to the periodic law, instead of the series as assumed at present, $\mathrm{Ir} < \mathrm{Au} < \mathrm{Pt} < \mathrm{Os}$, the arrangement $\mathrm{Os} < \mathrm{Ir} < \mathrm{Pt} < \mathrm{Au}$ would appear more probable. Since the atomic weight of gold, Au = 196·2, has been determined with tolerable accuracy, it seemed probable that the atomic weight of platinum must be less than 196. For the determination of this weight the author selected the double salts of the tetrachloride with ammonium and potassium chlorides. The average value, as deduced from four analyses ranging from 194·35362 to 194·60576, was Pt = 194·46124. Reduction to a vacuum alters this result to 194·34050. The composition of the potassium salt is consequently:—

			Per cent Calculated.	Per cent Found.
Pt	=	194·46	40·119	40·110
2KCl	=	148·79	30·697	30·685
Cl_4	=	141·46	29·184	29·211
		484·71	100·000	100·006

Hence platinum takes the serial position $\mathrm{Ir} < \mathrm{Pt} < \mathrm{Au}$ which its properties, considered as a function of the atomic weight, demand.—*Berichte der Deutschen Chemischen Gesellschaft.*

The Alkaloids of Belladonna, Datura, Hyoscyamus, and Duboisia.—A. Ladenburg.—*Atropa belladonna* contains at least two alkaloids which may be provisionally distinguished as heavy and light atropine, the light kind being identical with hyoscyamine. *Datura stramonium* contains also two bases, a light and a heavy; the former is the more abundant, and the latter a mixture of atropine and hyoscyamine. The light daturine is identical with hyoscyamine. Hyoscyamus contains two bases, the one crystalline and the other amorphous.—*Berichte der Deutschen Chemischen Gesellschaft.*

ON THE

VOLUMETRIC DETERMINATION OF CHROMIUM AND MANGANESE ALONG WITH FERRIC OXIDE AND ALUMINA.

By E. DONATH.

Permanganate has hitherto been used in volumetric analysis only in titrations performed in neutral or acid solutions, and in such a manner that the permanganate solution is run into the liquid to be examined till a red colouration appears. But if we proceed inversely, adding the liquid to be tested to a strongly alkaline and hot permanganate solution (which has an energetic oxidising action), several metals may be determined, which form oxides capable of higher oxidation by the alkaline permanganate solution, in the presence of other metals whose oxides are simply precipitated by the alkali, but are not further oxidised by the permanganate, and have upon it no reducing action.

Among many cases of this kind the author has examined more closely a determination very important in a technical respect—that of chromium and manganese in presence of iron and alumina.

If a solution of permanganate is made strongly alkaline with sodium carbonate and a little caustic soda, heated to a boil, and a neutral solution of chromic oxide is run in, the chromic oxide is at once converted into chromic acid, whilst manganese peroxide is separated out. The process is completed when the supernatant fluid has the pure yellow tint of alkaline chromates without the slightest reddish tinge, which may be recognised with sufficient distinctness.

The presence even of considerable quantities of ferric oxide and alumina in the solution containing the chrome does not prevent the completion of the reaction from being distinguished, since these oxides, if precipitated in heat, are rapidly deposited along with the manganese peroxide. If the approximate relation of the alkaline permanganate to the chrome solution in question has been determined by a preliminary experiment, on further titration the end of the reaction can be observed with sufficient accuracy. In fact the volumetric determination of chromium is in this manner rendered possible without the previous separation of iron and alumina.

If the neutral solution of a manganese salt is allowed to flow into the hot alkaline permanganate a precipitate is formed at once, containing the manganese of both the solutions. The process is at an end when the supernatant liquid is colourless.—*Berichte der Deutschen Chemischen Gesellschaft.*

ON THE

VENTILATION OF HALLS OF AUDIENCE.[*]

By ROBERT BRIGGS,
Member of the American Society of Civil Engineers.

It is not too great an admission to say that the Ventilation of Halls of Audience—that is, assembly-rooms, lecture-rooms, churches, theatres, and similar places—has not yet been generally effected in the most satisfactory manner.

All rooms, where many people are gathered together, are liable to become more or less offensive after a brief duration of session, and noticeably more objectionable as the session lengthens.

The flippant writer who records and publishes the circumstances does not hesitate to ascribe the defect to "want of scientific knowledge," with the implication that either he himself possesses or that he can readily produce the encyclopædia which contains such information. Those who have practically to do with the erection of buildings or the construction of apparatus for ventilating and warming the same, and especially those in whose charge the finished buildings and their apparatus are placed, are well aware that the teachings of the books or the records of practice have not gone beyond the studies of requirements, most frequently under conditions not applicable to our climate of the northern United States; or further than an incomplete description of the details of apparatus, which certainly have been evolved in a very perfect way in the workshop. In this regard of apparatus as a whole, it may be averred at once that, for more than twenty years, the practice of American contractors has been such as will meet every requirement of supply of air in any quantity and at any temperature desired.

The literature of ventilation is tolerably voluminous, but a few books, now over a quarter of a century old, give with much uniformity of repetition all that is written on the subject.[*]

Most writers are diffuse. The theory of ventilation has been based upon considerations rather than investigations. Views have to be supported in lieu of facts ascertained. The experiments and observations in the direction of chemical or pathological inquiry have, in a great measure, failed to give results compatible with evident physical wants. Ventilation of occupied places, in general, means only the supply of air for health and comfort in requisite quantities. But the uncertain element in this simple proposition is, what quantities are requisite?

The real quantity of air impaired by any one individual is small in any case, although it varies in amount with all the conditions of life and health of the individual, especially also for any one individual as to rest or activity, until limits three times in excess and one-half in diminution of what is impaired in the state of comparative rest are reached.

In air, at mean temperature of 60 to 70 per cent of hygrometry, an adult man, when awake and at rest at his ease, in similar condition in general to one of an audience in a public hall, may be taken to make sixteen respirations, of 30 cubic inches each, or 480 cubic inches, in a minute.[†] This inhaled air at say 70 degrees will have, when in American summer condition of humidity, about 70 per cent of complete saturation, or about $1\frac{7}{10}$ per cent of its volume will be aqueous vapour, and about $\frac{4}{100}$ of a per cent of its volume will be carbonic acid, while the remainder will be nitrogen and oxygen in the usual constant ratio of about four to one which exists everywhere in the atmosphere. The exhaled air will be found to have lost about one-fifth the oxygen inhaled, by the formation of carbonic acid; it will have nearly three times as much aqueous vapour, and nearly a hundred times as much, or about 4 per cent of its volume, of carbonic acid; while, notwithstanding the greater density of this carbonic acid gas, in consequence of the increase of temperature from 70 degrees to 90 degrees, and also of the levity of the

---

[*] A paper presented to the American Society of Civil Engineers, January 26, 1881.

[*] "A Course of Experimental Philosophy," by Dr. Desaguilliers, London, 1723; "Conducting Air by Forced Ventilation," by the Marquis de Chabannes, London, 1818; "Principles of Warming and Ventilation," by Thomas Tredgold, London, 1824; "Theory and Practice of Warming and Ventilating," by an Engineer (anon.), London, 1825; "Popular Treatise of Warming and Ventilation," by Charles James Richardson, London, 1839-56; "Practical Treatise on Warming of Buildings, &c.," by Charles Hood, London, 1844; "Illustrations of Ventilation," by Dr. David Boswell Reid, London, 1844; "Dictionary of Arts, &c.," by Dr. Andrew Ure, London, 1846; "Practical Treatise on Ventilation," by Dr. Morrell Wyman, Boston, 1846; "Traité de la Chaleur," par E. Péclet, Paris, 1843-60; "Etudés sur la Ventilation," par Genl. Arthur Morin, Paris, 1863.

The above is merely a list of the more important works. A complete list for this century is perhaps fifty volumes, mostly since 1850, with possibly important articles in a hundred periodical or serial publications. It is proper that the most valuable recent work should be named, wherein the physiology of ventilation is most clearly set forth; to wit, "Military Hygiene," by Dr. Edmund Parkes, London, 1863. The last edition of this work is edited and enlarged by Dr. F. S. B. François de Chaumont, London, 1878.

The indispensable library books of reference in the above are Wyman, Péclet, Parkes, Reid, Tredgold, Hood. . . .

[†] Experiments of Dr. Edward Smith. *Proc. Roy. Soc.*, 1859.

aqueous vapour, the exhaled air is really about 3 per cent lighter than the inhaled air.

This statement of the figures of respiration has been carefully prepared, and may be implicitly relied upon. It is presented in the outset of this paper as a foundation on which to build much of the argument to follow, and is especially intended to meet two popular fallacies.

The opinion is entertained by many people, some of whom ought to have informed themselves better, that the expired breath is heavier than the air, and, as a heavier body, it falls to the ground. The contrary is certainly the case. Notwithstanding the direction given to the breath when breathing from the nostrils, the column of breath ascends in all places where the temperature of the air is below 15 degrees. The diffusion of the exhaled breath—that is, the mixture into air near by—will of course take place nearer to any person when the flowing off of the stream of exhalation is impeded by the want of difference of temperature between the breath and the air. In any room at the temperature of comfort, 70 degrees to 72 degrees (with proper humidity), the diffusion of the breath will occur above the heads of the persons, and the fresh air for inhalation will be derived from the current ascending along the person—a current induced in part by the ascensive force of the expired air, and in part by the bodily heat of the person himself. This assertion is to be qualified, however, by admission of effect from established or enforced currents of artificial ventilation, which may modify, or even reverse, the natural flow.

The second popular error is, that the carbonic acid of itself separates and falls to the ground by virtue of its greater specific gravity (as a pure gas) than that of air. This is altogether a mistake. Carbonic acid has a density as compared with dry air of the same temperature, of 1·524 to 1. It can be poured from one vessel to another as water is poured, but for all that it "diffuses" or dissipates itself very rapidly, and when once diffused no length of time effects the least settlement or separation. There will be no less carbonic acid at the top of a tube 100 feet high than at the bottom. Carbonic acid, if colder than the air above it, will diffuse more slowly; if warmer than the air near it, so as to be more close to the same specific gravity, it will diffuse more rapidly. Whisky will lay on the top of water without mixing downwards; but once mixed with water, nothing but distillation will separate the two liquors. In point of fact the carbonic acid emitted with the breath is thoroughly, completely, and inseparably mixed with the breath; and the expired breath itself, as a whole, is rapidly, almost instantaneously, absorbed and inseparably mixed with the air of the room.

A man vitiates more air than is needed for respiration; an uncertain quantity of fresh air is both needed and vitiated in each minute by transpiration. A constant exhalation of carbonic acid transpires from the skin, by no means so large as that emitted from the breath, but probably one-fourth or one-fifth as great. The regularity of this transpiration nearly equals that of respiration. Accompanying this, it is probable that an absorption of oxygen corresponding to the equivalent of oxygen in the carbonic acid takes place. Experiments do not seem to have found the expired air from the lungs has lost more oxygen than the carbonic acid exhaled required, whence it follows that the supply of oxygen to form the carbonic acid transpired must be absorbed concomitantly. If now it be accepted that air containing the proportion of carbonic acid existing in expired breath is utterly spent for the purpose of breathing over again, and if an allowance of air for transpiration be made, it is established that each person in still life requires 580 to 600 cubic inches, or from 0·33 to 0·35 of a cubic foot of fresh air each minute, for perfect ventilation. Even this quantity can be reduced, as it is well known that in diving-bells men do live, and do continue to work, when the proportion of carbonic acid in the air of the bell rises to 8 per cent, instead of 4 per cent as it is found in once-exhaled air. Carbonic acid is an innocuous gas, quite harmless to animal life, except when it is substituted for oxygen in the air for breathing, and except also, in so far as its presence in large proportions interferes with the natural secretions from the lungs, and possibly from the skin.

Besides the carbonic acid, as one of the vitiations of exhaled air, there is known to exist a large proportion of aqueous vapour in the exhaled breath. Only $1\frac{7}{10}$ per cent in volume of the air inhaled at 70 degrees is vapour, while 5 per cent of the same volume is exhaled at 20 degrees higher temperature. (By weight the quantity of vapour will have been increased as 35 to 100.) To this excess of exhaled vapour derived from the lungs or fauces, there is to be added a large, but very variable, quantity of moisture imparted to the air of a room by insensible perspiration from the skin. The natural internal warmth of the body is very nearly 100° F., regardless of the heat of the external air, and comfort and health; even existence as a living animal depends upon the abstraction of heat from the surface of the body, so that the heat generated in the vital functions shall not elevate that internal temperature sensibly for any considerable length of time.

This part of my argument was more fully discussed in the paper "On the Relation of Moisture in Air to Health and Comfort," which was read by me before the American Institute of Architects at their meeting at Boston, in 1877. It was therein stated—"There are three means provided for the healthful dispersion of animal heat. The first is radiation to surrounding colder objects; the second, conduction to the atmosphere, which, for comfort, must be sensibly cooler than the body; and the third is evaporation from the moist surfaces of the lungs and throat, and evaporation from the roots of the pores of the skin. The first of these means—to the clothed person, at least—is comparatively ineffective; while the relative quantities of heat which may be eliminated in any given time or locality. by the last two, will probably be found nearly equal, in an atmosphere of about 70 degrees temperature, and of 65 to 70 per cent humidity."

It may be assumed, as the conclusion from data established by many experiments and observations, that 1·5 to 2·5 pounds of water are evaporated each day from a person in still life, or from one not taking violent exercise, or exposed to heat varying essentially from 70° F. This quantity of 2 pounds gives, under the conditions previously accepted, about three and a half times as much vapour evaporated by insensible perspiration as would be evaporated by breathing. If it be supposed that the moisture from insensible perspiration is to be absorbed and taken up by air of 70 degrees and of 70 per cent humidity, so that this air shall become saturated with humidity, it then follows that no less than 4 cubic feet of air must be supplied for this purpose to each person per minute.

(To be continued.)

PROCEEDINGS OF SOCIETIES.

PHYSICAL SOCIETY.

Saturday, May 28th, 1881.

Professor Fuller in the Chair.

Mr. C. Woodward exhibited apparatus for illustrating wave motions to a class. This consisted of a number of glass panes of equal size mounted on stands so that they could be ranged in a line or in rank and file. Patches of blue paper were attached to them to represent the moving particle of the wave, the positions being determined by a diagrammatic card which fitted each pane. A machine for showing Fresnel's conception of polarised light consisted of two axles fitted with a number of cranks, which supported a roof of rafters, bearing at their ridges a number of beads to guide the eye in tracing the wave motion. By turning the axles, the cranks shifted the frame of rafters, and the beads displayed the wave motion, which was vertical, elliptical, or circular, according to the adjustment.

Prof. G. **Forbes** explained the experiments made by him and Dr. **Young** to determine the velocity of light. The method employed was that of Fizeau, but instead of having one distant reflector and observing the total eclipse of the reflected ray by a tooth of the revolving wheel, two reflectors, one quarter mile behind the other, were used, and two rays, which were observed when of equal brightness. This method was found more accurate than Fizeau's own plan, and gave curves of brightness. The speeds of the toothed wheel were adjusted until the two rays appeared of equal brightness. The general result was that the velocity of the light of an electric lamp is 187,200 miles per second. Cornu found the light of a petroleum lamp to be 186,700 miles per second, and Michælson that of the sun to be 186,500 miles per second. The higher number of Prof. Forbes is probably due to the bluer light of electricity, for further experiments made with coloured lights and the spectrum, seemed to prove that the blue light travels probably over 1 per cent faster than red light. The experiments were made at Wemyss Bay, in Scotland.

Mr. **Spottiswoode**, P.R.S., said he had followed Prof. Forbes with interest, and these results appeared to modify our ideas of the luminiferous ether.

Lord **Rayleigh** enquired why it was that Jupiter's satellites showed no difference in tint in emerging from eclipse if red and blue rays travelled with unequal velocities, and

Prof. **Forbes** believed it due to the gradual character of the emergence of the satellites from behind their primary; according to the new theory variable stars should, however, be bluish with an increase of their light.

Prof. G. C. **Foster** pointed out that dispersion of the light in the air would rather have had the effect of retarding the blue rays.

Mr. **Hall**, of Baltimore, U.S., then exhibited the experiment in which a current of electricity flowing longitudinally along a thin foil of metal is caused to yield a transverse or lateral current by inserting the foil between the poles of a magnet. The lateral current is observed on a sensitive galvanometer, and care is taken in the first place to find points of connection with the foil, which yield no current before the magnet is applied. The results were that if iron is called +, the series is—iron +, silver −, gold −, platinum −, tin −. Curiously, nickel, though a magnetic metal, like iron, is − ; but on enquiry of Prof. Chandler Roberts, it proved that the nickel employed was perhaps impure. Cobalt ranges between iron and silver and is +, like iron.

Prof. **Perry** suggested that the displacement and huddling of the lines of flow of the current by the magnet might cause the current, but

Mr. **Hall** said that an experiment had been tried to test that, and went to prove that it was not due to crowding of these lines.

The **Secretary** read a paper by Prof. J. H. **Poynting** "*On the Change of Bodies from the Solid to the Liquid State.*" There are two types of change, exemplified by ice-water and by sealing wax; in the one a surface melting at the same temperature, in the other a softening of mass and heating. The first was thought by Prof. Forbes to be a limiting case of the second type; but the author gives reasons for supposing that it is rather an exchange phenomenon, analogous to what takes place when water evaporates, and the melting-point is reached when the number of molecules passing from the ice to the water is equal to the number passing from the water to the ice. The sealing wax type is analogous to the change of state in a liquid-gas above its critical point, where it changes gradually from a rather liquid to a certainly gaseous state.

NOTICES OF BOOKS.

Manual of Organic Qualitative Analysis. (Lehrbuch der Organischen Qualitativen Analyse.) By Prof. Chr. Th. Barfoed. Kopenhagen: A. F. Höst and Son.

We have here the third and concluding part of Prof. Barfoed's useful treatise. It treats of the alkaloids and the vegetable colouring matters, and gives finally general directions for the examination of bodies containing organic ingredients. The thoroughness and excellence of the work makes us regret the more that the author has confined himself within such narrow boundaries. Thus among the organic bases we find mention merely of morphine, narcotine, strychnine, brucine, quinine, cinchonine, and veratrine. It may surely be said that caffeine, nicotine, and atropine are of sufficient importance to be dealt with in a work like that before us, not to speak of the artificial bases, which now play so important a part in the arts, and from the large scale upon which they are produced, and their varied applications, may often have to be sought for and identified by the analytical chemist.

Among the vegetable colouring matters we find mention only of indigotine, the blue principle of litmus, turmeric yellow, alkanet red, hematoxyline, brasileine, and the red of annatto. Chlorophyll, morine, carthamine, &c., are wanting, as well as colours of animal origin such as carminic acid.

Whilst regretting, however, what we cannot help feeling as a deficiency, we gladly bear testimony to the satisfactory character of the author's method within the limits which he has thought proper to select.

The History of Salt: with Observations on its Geographical Distribution, Geological Formation, and Medicinal and Dietetic Properties. By Evan Marlett Boddy, F.R.C.S., F.S.S. London: Baillière, Tindall, and Cox.

We have here a curious and interesting monograph. Its origin is perhaps due to the strange fact that the dietetic use of salt is now condemned and denounced by certain "persons" devoid of medical, and indeed of scientific, knowledge *in toto*, but well aware that the easiest way to become a "man of the time" is to raise an outcry against some ancient and established custom. One of these worthies has declared salt to be the "forbidden fruit" of the Mosaic record. Whether the anti-salt movement will, like vegetarianism, the anti-vivisection outcry, or the opposition to vaccination, assume a malignant type and break out into an agitation is uncertain. But we think that Dr. Boddy has done well by showing the many benefits due to the use of this general condiment, relished as it is, not by man alone, but by many of the lower animals. The mischief arising from the prolonged or exclusive use of salted provisions, to which the author refers, is evidently not due to the presence of salt in the food, but to the absence of certain necessary constituents which are eliminated in the salting process. Consequently this fact furnishes no argument against the use of salt along with our diet. Nor must it be forgotten, as the author points out, that the beef and pork salted for consumption at sea is often of very bad quality, and that the quantity of salt is so great as to rank as an adulterant rather than as an antiseptic.

On a few points we can scarcely agree with Mr. Boddy. Thus we find him writing—"When the chemist wishes to decompose water—or, in other words, to liberate hydrogen from oxygen—he has no better agent to effect the purpose than this greenish coloured gas (*i.e.*, chlorine), because it has such a strong affinity for hydrogen." Water can, indeed, be decomposed by the action of chlorine, but the process is by no means convenient.

Elsewhere the writer speaks of common salt as being *adulterated* with sodium iodide. Considering the higher price of the latter, we may feel certain that it is never intentionally added, though salt obtained from sea-water or from certain brine-springs might contain iodides as an impurity.

The account given of the salt-mine of Wieliczka, as we know from personal examination, is somewhat overdrawn. Vast as are the workings, the number of shafts is so great that the miners have no occasion to spend their lives underground.

In fine, the work before us, though brief in its compass, gives proof of wide and varied learning, and will be found pleasant and instructive reading, useful even to persons who have not embraced the anti-salt heresy.

Proceedings of the American Pharmaceutical Association at the Twenty-eighth Annual Meeting. 1880. Philadelphia: Sherman and Co.

A large part of this goodly volume consists of chemical and pharmaceutical notes extracted from the journals of the whole civilised world, and selected with care and judgment. Pharmaceutical nomenclature is the subject of a long paper. On one point we must disagree with the writer. He maintains that the names stibium, kalium, and natrium are used everywhere except in England and the United States. Now in France potassium and sodium are used just as in England, and even in Germany the term "soda" is more generally employed among technical chemists than "natron." The Presidential Address deals with a very important question of the day—the devastation of the forests and the consequent extinction of important medicinal plants. Surely it is time that all civilised governments should interfere with the random destruction of trees, and should prevent goats and swine from being turned out at large.

CORRESPONDENCE.

BAROMETER PUMPS.

To the Editor of the Chemical News.

Sir,—I have just seen that a correspondence has taken place in your journal about Mr. Sprengel's claim to be the first inventor of barometer pumps. This claim I dispute. I obtained a patent in May, 1847, for improvements in sugar refining, one of which is the conversion of a vacuum pan into a large barometer by placing under a common vacuum pan a long pipe in a perpendicular position, which acts as a pump whereby the sugar is taken out of the pan by its own weight in the long pipe, and thereby the vacuum in the pan is not destroyed, and the process of sugar-boiling is carried on continuously. The syrup to be boiled is added in a special evaporator at the upper part of the pan, while the boiled sugar is taken out at the bottom of the pan through the barometer pump. The specification of my patent was published in patent journals in London in 1847, and it is possible that Mr. Sprengel took the idea of his mercury barometer pump from my sugar barometer pump. But at all events Mr. Sprengel was not the first inventor of a barometer pump. I claim that honour.

Herewith you have a copy of the specification of my patent as published in 1847, with an engraving of the barometer pump.—I am, &c.,

James Johnstone.

Experiment Rooms, 1, James Square,
Edinburgh, May 27, 1881.

[Mr. William Johnstone made the same claim in the Chemical News for July 25, 1879, and after careful examination we appended to his letter the following note:—"The quotations which Mr. Johnstone gives from his father's specification show that the 'Johnstone barometer pump' is an entirely different instrument from the Sprengel pump.' "—*Ed.* C.N.]

THE SO-CALLED "BUNSEN" PUMP.

To the Editor of the Chemical News.

Sir,—As a rule I do not think it advisable to take notice of anonymous communications, but let me assume "Verax" (Chemical News, vol. xliii., p. 231) to be a gentleman whose opinion deserves all consideration.

Hence I beg to say, in reply, that I am not aware of having published anything which could lead "Verax" to say that I had confessed my water-air-pump to be a comparative failure, and that I laid it aside as a non-success. My words (*Journ. Chem. Soc.*, 1865, p. 17) are "*that it* (the water-air-pump) *would furnish a simple and most efficient exhausting machine.*" It should not be necessary to mention that such an exhausting machine, however simple and efficient, is as little a filtering apparatus as a Bunsen burner is a distilling apparatus or a spectroscope.

As I have not published anything about the applications of my air-pumps—be they worked with oil, or water, or sulphuric acid, or mercury, or mixtures of liquids and solids —it appears that on this account "Verax," Prof. Roscoe, and others, do not consider me the legitimate inventor of these instruments. True, I am admitted to be the owner of the "*principle*," but still this poor principle is placed behind the application, apparently to illustrate that the horse is moved by the cart. In our utilitarian age one is expected not only to build a ship on a new principle, but to sail her as well and discover an America. This is hardly fair to the ship-builder.

Supposing my water-air-pump should be applied in future with great success by somebody who is not Prof. Bunsen (say "Verax") to something of great importance, which is not filtering, would it not be a misnomer to call this new and ingenious application, or adaptation, or *annexation*—or whatever else it may be—a "Bunsen's filter pump," being *ipso facto* a legitimate "Verax's —— pump," according to Verax's own showing?

But why should I resort to the future, if the past furnishes such ample proofs for my argument? Why do these advocates of application not speak of a "Graham's extraction and transfer pump"? Of a "Crookes's radiometer pump"? Of a "Frankland and Armstrong's combustion pump"? Of an "Edison and Swan's electric light pump"? and so forth. Surely these appliers of my pump deserve to be remembered in connection with it as much as Prof. Bunsen, *particularly the late Mr. Graham, who did more for this instrument than anyone since its invention.* Such is my opinion.

The hastening of filtration is only one instance of the many applications to which my instruments have been put, and most likely will be put as long as an atmosphere surrounds the earth. Hence the names "Bunsen pump" and "filter pump" are both *misnomers* for the reasons which I have given, or rather have been forced to give, not through "*susceptibilities*" of my own, but through the persistent misrepresentation of the facts by Prof. Bunsen's over-zealous friends.—I am, &c.,

H. Sprengel.

London, Savile Club, May 26, 1881.

THE ESTIMATION OF PHOSPHORUS IN STEEL.

To the Editor of the Chemical News.

Sir,—I am glad that "Phosphorus" has done me the justice to acknowledge that he "misconstrued" my results, though I regret that he has not withdrawn in a more graceful manner statements that strained the courtesies of scientific debate.

The issue which "Phosphorus" raised in his first letter as to the conversion of the pyro- into ortho-phosphate, and which made "the value of the results very slight," he is now "not prepared to deny," although he has "doubts." Now, Sir, if "*arguments*" do not depend for their cogency on the identity of their employer, when "*doubts*" are arrayed against the results of actual experiment, the identity of the employer of the "doubts" becomes a factor of some moment. If "Phosphorus" will make a series of experiments on pure $Mg_2P_2O_7$, and test the question practically, I think his doubts will vanish.

"Phosphorus" intimates that the last paragraph of my letter was based on a misconstruction of *his* last paragraph, which he now says referred to my *first* experiments. In obedience to his request I have re-read his letter, and find these words:—"Conversely by his suggested modified plans he would re-dissolve 234·9 m.grms. of yellow precipitate in order to convert it into 13·9 m.grms. of magnesium pyro-phosphate! And this is done for the purpose of getting a more accurate result!" But as the "suggested modified plans" were the *last* experiments, I cannot quite see how to reconcile the two statements.

I must thank "Phosphorus" for having defined his position, as I must confess I was a little hazy as to what his views really were. Knowing them to some extent now I shall demonstrate to "Phosphorus" that his standpoint is a most untenable one. He makes the assertion that rapidity is only a secondary consideration in an estimation of phosphorus. Well, Sir, any one acquainted with the routine of a busy steel works will be able to form an estimate of the value of this statement. Admitting that the results obtained by a careful molybdate estimation are accurate enough for practical purposes, but that by the modified process results can be obtained *more quickly and more accurately*, which process is to be preferred? The question is not which method gives the heavier precipitate, but which is the more accurate? Has "Phosphorus" any data to prove that the proposed method is not accurate? Certainly up to the present he has made no attempt in that direction, excepting the objection that the pyro-phosphate is soluble in the liquid from which it is precipitated. This would make the results *low*, whereas they always come higher than the molybdate; therefore if I am correct in interpreting this objection into an insinuation that the modified method is low, much more then will the molybdate be low.

As the issue between "Phosphorus" and myself seems to be now pretty clear, I hope he will abandon generalities, which are proverbially difficult to meet, and fight out the controversy on concrete data.—I am, &c.,

J. Oliver Arnold.

Sheffield, May 23, 1881.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences. No. 17, April 25, 1881.

Examination of Materials from the Vitrified Forts of Craig Phadrick, near Inverness, and of Harmannswillerkopf, in Haute Alsace.—M. Daubrée.—These materials furnish a new opportunity for remarking the wonderful facility with which crystalline mineral species may be formed in a vitreous mass suitably heated; they contribute to throw light on the theory of metamorphism.

Researches on Piperidine.—A. W. Hofmann.—The author describes dimethyl-piperyl-ammonium iodide, a new base, which he names provisionally dimethyl-piperidine; trimethyl-piperyl-ammonium iodide, and piperylene, a carbide of the composition C_5H_8.

Essence of Licari Kanali.—H. Morin.—This essential oil is obtained from a tree of Cayenne, a species of *Acrodiclidium*. The oil boils at 198°; its sp. gr. is 0·868; its rotatory power is −19°. Its composition is expressed by the formula $C_{20}H_{18}O_2$. It appears to be an isomer of Borneo camphor.

A Nodule of Chromite in the Interior of Meteoric Iron from Cohahuila, Mexico.—Lawrence Smith.—The nodule in question was composed of chromic and ferrous oxides, with a little magnesia, cobalt, and silica.

Normal Production of the Three Systems of Fringes of Rectilineal Rays.—M. Crollebois.—A mathematical paper, not suitable for abridgment.

Disturbing Causes of Telephonic Transmissions.—M. Gaiffe.—Two rods of equal length having been cut from one and the same bar of steel capable of being strongly polarised without having been tempered, one of them was magnetised as strongly as possible, and they were then placed in a telephonic circuit. On striking them both in the same manner the author found that the magnetised bar gave energetic currents, whilst the other gave relatively but little. This fact seems to find a satisfactory explanation in the theory of Ampère.

Origin of Nephrozymase in the Kidneys.—MM. J. Béchamp and Baltus.—The authors prove that the albumenoid ferment, nephrozymase, exists in urine obtained by urethral fistulæ, that it is directly secreted by the kidneys, and that it exists in larger proportions before its arrival in the bladder than after its stay in that organ.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin. Vol. 13, No. 8.

Compounds of Organic Bases with the Haloid Salts of Mercury.—Otto Klein.—The author has obtained and examined compounds of aniline and mercuric bromide, aniline and mercuric iodide, para-toluidine and mercuric bromide, para-toluidine and mercuric iodide, and the corresponding compounds of ortho-toluidine.

Di-oxy-benzo-phenon.—W. Staedel and E. Sauer.—The authors have obtained β-di-oxy-benzo-phenon, which is much more soluble in water than the α- compound, and crystallises in stellar groups of small white needles.

Iso-indol.—W. Staedel and Fr. Kleinschmidt.—The authors give C_8H_7N as the preferable formula for this compound.

Brom-nitro- and Brom-amido-anisols.—W. Staedel and G. Damm.—The authors describe mono-brom-para-nitro-anisol, mono-brom-para-anisidine, and di-brom-para-anisidine.

Vapour-Tensions of Halogen-Substituted Ethans.—W. Staedel.—The author lays down the generalisation that with the decreasing volatility of the liquid, the increase of tension for 1° becomes less.

A New Synthesis of Oxygenous Organic Bases.—W. Staedel and O. Siepermann.—This memoir does not admit of useful abstraction.

Action of Certain Metals and Non-Metals upon Phosphorus Oxychloride, and the Existence of Leverrier's Phosphorus Oxide.—B. Reinitzer and H. Goldschmidt.—In the more usual case the molecule of phosphorus oxychloride is deprived of its oxygen with formation of phosphorus trichloride. In rarer cases all the three atoms of chlorine pass to the metal, phosphorus oxide, P_4O, being formed.

Vapour-Density of Iodine.—Fr. Meier and J. M. Crafts.—This long and important paper cannot be intelligibly reproduced without the accompanying figures. From their experiments the authors conclude that the density of iodine becomes abnormal between 600° and 700°, and decreases progressively with the rising temperature, until at about 1390° it becomes 0·60 of the theoretical amount. We conjecture that this diminution would continue, and at higher temperatures would reach the proportion of 0·5. If this abnormal density is due to dissociation we assume that the molecule I_2 is gradually resolved into $I+I$, or that the group representing a physical unit is split into two parts, and we do not believe that a new hypothesis on the constitution of iodine can be founded on the above results.

Brom-carbon Oxide.—A. Emmerling.—The author's researches have not been completed. The compound obtained is a heavy colourless liquid, of the same penetrating suffocating odour as that of chlor-carbon oxide. The vapours have the property of causing vulcanised india-rubber to swell in a remarkable degree.

Behaviour of Antimony Penta-chloride with Phosphorus Trichloride.—H. Kœhler.—The compound obtained is phosphor-antimony deca-chloride.

Action of Zinc upon Succinimide.—Chichester A. Bell.—The chief product of the decomposition is pyrrol, mixed with other basic substances.

Probable Occurrence of Furfuran and a Homologue among the Products of the Destructive Distillation of Pine Wood.—A. Atterberg.—The homologue of furfuran thus obtained is named by the author sylvan, $C_4H_3O.CH_3$, and forms a member of a little-known group of compounds deducible from furfuran (tetra-phenol), and including furfuran, sylvan, furfurol, fucusol, pyro-mucic, and pyro-comonic acids, comenic, pyro-meconic, and dehydro-mucic acids, and meconic acid.

A Modification of Zulkowsky's Apparatus for the Volumetric Determination of Nitrogen.—E. Ludwig.

Determination of Nitrogen.—Hugo Schiff.—These two papers cannot be reproduced without the accompanying illustrations.

On α-Di-dinitro-phenyl-ether.—C. Willgerodt.—This ether when pure is colourless, melting at 195°, and separates from most of its solvents in short thick crystals. It is plentifully soluble in glacial acetic acid, benzol, chloroform, and amylic alcohol.

Abietic Acid.—W. Kelbe.—Abietic acid, $C_{44}H_{64}O_5$, is obtained from that portion of crude resin-oil which is dissolved by caustic soda. The author gives an extended account of its properties.

Nitro-benzoic Acid.—A. Claus.—A memoir written to controvert the view of Fittica (*Berichte*, 13, 711) that there exist more than three mono-nitro-benzoic acids.

Cymols.—A. Claus.—A description of ortho-cymol, meta-cymol, and the behaviour of para-cymol with sulphuric acid.

Certain Derivatives of Iso-butyl-aldehyd.—A. Lipp.—Not adapted for useful abstraction.

Synthesis of Chinoline.—W. Kœnigs.—Chinoline is obtained by the action of glycerin and sulphuric acid upon a mixture of nitro-benzol and aniline.

Fluorescence in the Anthracen Series.—C. Liebermann.—The author gives very extensive lists of the fluorescent and non-fluorescent bodies belonging to this series.

New Methods of Forming Diamines.—A. Bernthsen and F. Szymanski.—The authors show that diamines are formed by the reduction of amidines.

Ortho-anisidine.—O. Mühlhäuser.—Not suitable for abstraction.

Vol. 13, No. 9.

Determination of the Value of Zinc and Zinc-powder.—F. Beilstein and L. Jawein.—The apparatus used by the authors cannot be intelligibly described without the aid of the accompanying figure.

The Atomic Weight of Antimony: A Preliminary Communication.—Josiah P. Cooke.—The author's repeated and very carefully-conducted determinations yield a mean value of 120·01 for the atomic weight of this element.

The Combustion-Heat of Sulphur.—Julius Thomsen.—The author determines the combustion-heat of rhombic sulphur = 71,080 cals.; that of monoklinar sulphur = 71,720 cals., the transit from the latter to the former state being accompanied with a disengagement of 640 cals. As Favre and Silbermann found the combustion-heat of rhombic sulphur 71,040 cals., whilst M. Berthelot makes it only = 69,100 cals., the determination of the latter chemist is 2·7 per cent too low.

New Lactones.—R. Fittig.—The author describes three new lactones—that of normal capronic acid, that of normal valerianic acid, and one obtained on the dry distillation of terpenylic acid.

The Constitution of Liquid Chlorolactic Acid and Oxacrylic Acid.—P. Melikoff.—Not suitable for abstraction.

On β-Bromolactic Acid.—P. Melikoff.—This compound is obtained from oxyacrylic acid by the addition of hydrobromic acid.

A Word on O. Fischer's Memoir on Diamido-tri-phenyl-methan.—C. Böttinger.—A reply to O. Fischer's paper, *Berichte*, p. 665.

Constitution of the Products of the Action of Bromine and Nitric Acid upon Aromatic Amido-Compounds and upon the Six Isomeric Dibrom-toluols.—R. H. C. Nevile and A. Winther.

The Six Tri-brom-toluols, the Three Tetra-brom-toluols, and Penta-brom-toluol.—R. H. C. Nevile and A. Winther.—These two papers may be found in full in the *Journal of the Chemical Society*.

Kreatinoid Compounds of the Aromatic Group (No. III.).—Peter Griess.—The author describes ortho-benz-glyco-cyamidine, α-ortho-methyl-benz-glyco-cyamidine, and the corresponding β-compound.

Biebrich Scarlet.—W. v. Miller.—The author admits that the red tinctorial principles of this dye are really sulphacids of a complex azo-compound.

Decomposition of Simple Organic Compounds by Zinc Powder.—Hans Jahn.—Methyl-alcohol is completely resolved by zinc powder into carbonic oxide and hydrogen. Ethyl-alcohol yields hydrogen, carbonic oxide, and light carburetted hydrogen.

Victor Meyer's Determination of Vapour-Density.—Lothar Meyer.—The author figures an arrangement for avoiding a source of error of which V. Meyer complains (*Berichte*, pp. 813 and 814).

Guanidine-like Compounds.—F. Berger.—The author describes a compound which he has obtained, $C_9H_{11}N_3O_2$, and which he names glycolyl-mono-phenyl-guanidine.

Reply to H. Kolbe and E. v. Meyer.—W. Hempel.—A lengthy polemical paper in reference to the *Journal für Praktische Chemie*, vol. 21, No. 9.

Quantitative Determination of Aceton in Methylic Alcohol.—C. Krämer, after criticising previous methods for the quantitative and qualitative examination of methyl-alcohol, proposes an improved process. The requisites are some graduated pipettes, a mixing cylinder holding 50 c.c., a tared watch-glass, and the following reagents: Double normal solutions of iodine and of soda, and ether free from alcohol. Into the mixing cylinder are poured 10 c.c. of the soda solution, then 1 c.c. of the sample in question, and, after well shaking, 5 c.c. of the iodine solution, the shaking being repeated. The iodoform which separates in flocks is dissolved by the addition of 10 c.c. of ether. After standing for a short time a stratum of ether floats above the solution of sodium iodide, and amounts to about 9·5 c.c. An aliquot part of this (5 c.c.) is drawn off with a pipette and evaporated in the tared watch-glass. After the escape of the ether the glass is dried for a short time over sulphuric acid and weighed. The increase of weight shows the iodoform, which is easily calculated into aceton. 1 mol. aceton $= 58 + 6$ iodine $= 127 \times 6$ gives 1 mol. iodoform $= 394$, of which we have $\frac{9\cdot5}{5}$ on the watch-glass. The weight obtained is therefore multiplied by $\frac{58\cdot9\cdot5}{394\cdot5} = 0\cdot28$ approximately to find the aceton in a c.c. of the alcohol.

Influence of the Foreign Constituents of Wood Spirit upon the Methylation of Aniline.—G. Krämer and M. Grodzky.—Among these ingredients aceton is the most injurious, not merely decreasing the yield, but rendering the violet colours produced of an impure tone.

Communication on Iodine.—V. Meyer.—In a preliminary critique on the results of MM. Crafts and F. Meier, the author questions their view that a minimum is attained at 4·39 (I_1), and hopes to prove that the end of the dissociation will be reached at $\frac{1}{2}I_2$ (2·93).

Aromatic Amido-ketons.—Oscar Dœbner.—A description of the behaviour of benzoyl-chloride with phthalanil, and of benzo-aniline.

Roofing Copper.—Alex. Muller.—The author ascertains the relative power of samples of sheet copper to resist corrosion by exposure to the vapours of hydrochloric acid.

Vol. 13, No. 10.

Knowledge of the Camphor Chlorides.—F. v. Spitzer.—The author concludes that the bodies described by Pfaundler as camphor dichloride, melting at 70°, and mono-chloride, melting at 60°, are merely mixtures.

Behaviour of Succinimide with Phosphorus Pentachloride and with Zinc Powder.—A. Bernthsen.—A preliminary communication which the author makes to secure his right to continue his researches on the subject.

Progress of Dissociation in the Vapour of Iodine.—Alex. Naumann.—The author gives a table of the densities, degrees of decomposition, and progress of dissociation of the vapour of iodine. He holds that the progress of dissociation which appears in this table harmonises with the general law deduced from the mechanical gas-theory respecting the progress of dissociation with a rising temperature, according to which "the increments of decomposition corresponding to equal differences of temperature increase constantly from the temperature of commencing dissociation till it is half completed, and decrease in a similar manner until the temperature of the completion of dissociation"—a law confirmed experimentally by the investigation of the progress of the dissociation of the vapours of other bodies, especially of hyponitric acid (*Ann. Chem. Pharm.*, 1868, suppl., 6, 205, and Alex. Naumann's "Allgemeine and Physikalische Chemie," p. 240). In the decomposition of the vapour of iodine there is a great range of temperature of the dissociation. The process begins at about 600°, and at 1270° it is half completed. May we assume that the completion of the process lies higher by a number of degrees equal to the difference?

Chole-camphoric Acid and its Relation to Cholanic Acid.—P. Latschinoff.—Chole-camphoric acid under a variety of circumstances loses the elements of water, and passes into cholanic acid. The inverse process is still more easy.

Remarks on the Papers of MM. von Miller and on Biebrich Scarlet.—Leo Vignan and J. Boas Boasson.—In the *Berichte*, 13, p. 543, Von Miller describes "Biebrich Scarlet" as having been introduced into commerce by Kalle and Co., and as having been for some time manufactured by the Berlin "Actien Gesellschaft für Anilin Fabrikation." On p. 800 Nietzki claims the priority of the discovery for Kalle and Co., and for himself. The firm of Henriet Komann and Vignan, colour makers of Lyon, deposited with the Conseil des Prudhommes an account of the preparation of these colours as far back as Aug. 22, 1878, more than a year before the date of the patent of Græssler (Jan. 29, 1880, and Krügerer, Nov. 27, 1879), and six months before the Biebrich scarlet was introduced into trade. The document thus deposited runs: "We wish to secure for ourselves the priority of the discovery of the colouring-matters produced by the action of the phenols, amines, and their sulphacids upon the diazo-compounds of amido-azo-benzol, amido-azo-toluol, and amido-azo-naphthaline. The colours can be advantageously substituted for the vegetable dyes. The accompanying sample is obtained by the action of sulpho-naphtholic acid upon diazoised amido-azo-benzol, and yields upon silk and wool shades resembling those produced by orchil."

Constitution of the Reduction-Product of Succinyl-chloride.—A. Saytzeff.—The author obtains this substance by the fractional distillation of oxy-butyric acid. The reduction-product is not an aldehyd, but the anhydride of normal oxy-butyric acid, and belongs in the series of Fittig's lactones.

Xanthogenic Acid, a Precipitant of the Albuminoids.—P. Zöller.—Potassium xanthogenate added to acidulated solutions of the various modifications of albumen produces a flocculent precipitate.

Globulinoid Substances in Potato Tubers.—P. Zöller.—The author confirms the presence of these substances in the potato, and describes a method for their isolation.

Formation of Hydrogen Peroxide and Ozone on the Action of Moist Phosphorus upon Air.—Albert R. Leeds.—Already inserted.

New Measurements of the Densities of Solid Organic Compounds (Series III.).—H. Schrœder.—This important paper does not admit of abridgment.

Amido-lactic Acids of Different Origin.—E. Erlenmeyer.—Not adapted for useful abstraction.

Determination of Vapour-Densities.—J. Piccard.—The author describes and figures a modification of the apparatus used by his colleague V. Meyer.

Tropeines.—A. Ladenburg.—The compounds here described are oxy-benzoyl-tropeine, para-oxy-benzoyl-tropeine, ortho-oxy-benzoyl-tropeine, benzoyl-tropeine, phthalyl-tropeine, atropyl-tropeine, cinnamyl-tropeine, and oxy-toluyl-tropeine.

Derivatives of the Toluidines.—J. Cosack.—An account of ortho-tolyl-urea, meta-tolyl-urea, meta-tolyl-urethan, para- and ortho-tolyl-glycocoll, meta-ditolyl-amine, nitroso-para-ditolyl-amine, and aceto-meta-ditolyl-amine.

Separation of Hippuric and Benzoic Acid in Fever.—T. Weyl and B. von Amep.—A normal rabbit fed on milk and oats excretes hippuric acid and generally also free benzoic acid. During fever it excretes more free benzoic acid and less hippuric acid. A normal dog fed on meat and bacon excretes always hippuric acid, and generally small quantities of free benzoic acid. During fever the excretion of the former acid decreases.

Thermic Formation of the Oxides of Nitrogen.—Julius Thomsen.—The author points out that the determinations published by M. Berthelot (*Comptes Rendus*, 90, 779) agree most closely with his own, published at an earlier date, the only exception being in the case of nitrous oxide. Still the French chemist pronounces the author's method as wanting in a guaranteed basis.

A further Simplification of the Process of Dumas for the Determination of Nitrogen.—Karl Zulkowsky.—This important paper requires the accompanying illustration.

MEETINGS FOR THE WEEK.

Monday, 6th.—Royal Institution. General Monthly Meeting, 5.
Tuesday, 7th.—Royal Institution, 3 p.m. "Thomas Carlyle," Prof. H. Morley.
Wednesday, 8th.—Microscopical, 8.
—— Geological, 8.
Thursday, 9.—Royal Institution, 3. "Russsian Litterature: Tourgenieff," Prof. C. E. Turner.
—— Mathematical, 8.
Friday, 10th.—Royal Institution, 8. "Origin and Identity of Spectra," Prof. Dewar, 9.
—— Quekett, 8.
Saturday, 11th.—Royal Institution, 3. "Russian Literature: Nekrasoff," Prof. C. E. Turner.
Saturday, 12th.—Physical, 3. "The Hardening of Steel," Prof. W Chandler Roberts, F.R.S. "Curves of Electro-magnetic Induction," W. Grant.

IRISH HILL BAUXITE (Alum Clay).

The IRISH HILL MINING CO. are now, and always have been, the LARGEST PRODUCERS OF THIS CLAY, of Superior Quality, and supply the Manufacturers of Alum, Sulphate of Alumina, and Alum-Cake, of the United Kingdom, America, and the Continent, almost exclusively.

Analysis by John Pattinson, Esq.

	Dried at 212° F.		
	Gertrude (extra qual.)	1st Quality.	2nd Quality.
Alumina	59·00	53·83	52·00
Peroxide of Iron	0·47	1·57	4·57
Silica	18·00	8·67	12·00
Titanic Acid		5·80	6·20
Lime, Magnesia, Potash, Soda, and Sulphuric Acid	0·23	0·83	1·14
Combined Water	22·30	29·27	24·00
	100·00	99·97	99·91

Our MINES, DRYING KILNS, and GRINDING MILLS are situated very close to the Shipping Ports of BELFAST and LARNE, and adjacent to Railways running alongside both Steamers and Sailing Vessels at both Ports, from either of which shipping is abundant and cheap, therefore we can guarantee Regular Delivery as Buyers require it, and are prepared to quote prices f.o.b. c.i.f., or delivered at any Port, in Bulk or Bags, Lump or Ground.

GEO. G. BLACKWELL, *Managing Director.*

Richmond Buildings, 26, Chapel St.,
Liverpool.

Established 1798.

ROBERT DAGLISH & CO.,

ENGINEERS, BOILER AND BRIDGE MAKERS, MILLWRIGHTS,
BRASS AND IRON FOUNDERS.

Manufacturers of every description of Condensing, or High-pressure Blowing, Pumping, Rolling, Winding, and Patent Steam-engines, of any required power, for Irrigating, Draining, Mining, Rolling Mills, or Water Works purposes, and Manufacturers of every description of Chemical, Colliery, Copper Ore, Gold Mining, Glass, and Rock-salt Machinery.

Black-ash Revolving Furnaces of the Most Approved Type.

Bessemer Steel-Rail Plant.

Compressing-Engines for Collieries, Iron Works, and Weldon's Patent Bleaching-Powder Process.

Caustic, Chlorate, Decomposing, Nitre Nitro-Glycerine, Iodine Potash, Sulphur, Acid, and Oxalic Pans.

Gas Producers Patent for Heating and other Purposes.

Pyrites Burners for Irish, Norwegian, and Spanish Ores of Improved Construction.

Patent Rousing Machinery for Brewers.

Retorts, Acid, Gas, Iodine, Nitric, Nitre Nitro-Glycerine and Vitriol Refining.

Steam Superheaters improved for Oil, Tar, and Resin Refining.

Steam Sulphur Melter.

Stills for Oil, Resin, and Tar.

Wheels, Bevel, Mitre, and Spur Moulded on the Shortest Notice by Patent Machinery.

Makers of Mactear's Patent Carbonating Furnace, Jones and Walsh's Patent Sulphate of Soda Furnace, Parnell and Simpson's Patent Causticiser, and Kynaston's Patent Alum Plan

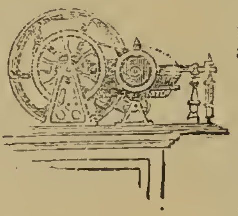
Lists sent on Application.

Photographs, Plans, and other information supplied on receipt of Order.

ST HELEN'S ENGINE, BOILER, AND BRIDGE WORKS
AND FOUNDRY,
LANCASHIRE.

Carr's Patent Paint and Drug Mill.

Approved by some of the most eminent Chemists, and awarded the Silver Prize Medals of the Manchester and Liverpool, and the Middleton Agricultural Shows.



From Messrs. E. H. Smyth & Co., 21 Duke Street, Edinburgh, and 69, Coleman Street, City, London.—The small Levigator Mill we recently got from you works most efficiently, and is a great economiser of time.

The chief feature in this machine is, that although it can be turned with ease by a boy, it has immense frictional power for levigating purposes. This is caused by the runner being driven at a much greater speed, but in the same direction, than the bowl. The surfaces being Minton ware, they are clean, smooth, and durable.

Testimonials on application.

£11 nett cash, delivered in Manchester.

The diameter of the bowl is 18 ins., and it and the runners are made of Minton ware. It is useful for Painters, Chemists, Grocers, and Cooks, for triturating and mixing Medicines, Vegetable Powders, Ointments, Paints, Sugar, Salt, Spices, Herbs, Meat for Potting, and will grind the coarsest Emery into a nearly Impalpable Powder in a few seconds. The pan can be tilted for emptying, as shown in the dotted lines; it can be worked by hand or power.

SOLE MAKERS—
W. H. BAILEY & Co., Albion Works, Salford, Manchester.

TETRACHLORIDE OF CARBON.
BISULPHIDE OF CARBON.
CHLORIDE OF SULPHUR.

JESSE FISHER & SON,
Phœnix Chemical Works Ironbridge.

Wanted, to Purchase Volumes 1, 2, 3, 4, and 5 of the "Journal of Society of Telegraph Engineers."—Address, A. E. A., Chemical News Office, Boy Court, Ludgate Hill, London, E.C.

THE CHEMICAL NEWS.

VOL. XLIII. No. 1124.

ON THE
SPECTRUM OF MAGNESIUM UNDER VARIOUS CIRCUMSTANCES.*

By G. D. LIVEING, M.A., F.R.S., Professor of Chemistry, and
J. DEWAR, M.A., F.R.S., Jacksonian Professor,
University of Cambridge.

SINCE our last communication on this subject (*Proc. Roy. Soc.*, 1880, No. 200), several authors—Ciamician, Cornu, Fievez, and Lockyer—have published observations on the spectrum of magnesium, to some of which allusion is made in the sequel, but these observations by no means exhaust the subject. Our own observations, carried on for a considerable time, have extended to new regions and a variety of circumstances, and the summary of them which we now present to the Society will, we hope, help to bring out the connexion between some of the variations in the spectrum of this element and the conditions under which it is observed, and to throw additional light on the question of the emissive power for radiation of short wave-lengths of substances at the temperature of flames to which we alluded in our paper on the spectrum of water (*Proc. Roy. Soc.*, 1880, No. 201).

We begin with an account of these observations.

Spectrum of the Flame of Burning Magnesium.

When magnesium wire or ribbon is burnt in air, we see the three lines of the b group, the blue line about wave-length 4570, first noticed by us in the spark spectrum (*Proc. Roy. Soc.*, vol. 27, p. 350); and photographs show, besides, the well-known triplet in the ultra-violet between the solar lines K and L sharply defined, and the line for which Cornu has found the wave-length 2850 very much expanded and strongly reversed. These lines are all common to the flame, arc, and spark spectra; and the last of them (2850) seems to be by far the strongest line both in the flame and arc, and is one of the strongest in the spark. But, in addition to these lines, the photographs of the flame show a very strong, somewhat diffuse, triplet, generally resembling the other magnesium triplets in the relative position of its components, close to the solar line M; and a group of bands below it extending beyond the triplet near L. These bands have, for the most part, each one sharply defined edge, but fade away on the other side; but the diffuse edges are not all turned towards the same side of the spectrum. (The positions of the sharp edges of these bands, and of the strong triplet near M, were shown in a figure.) It is remarkable that the triplets near P and S are absent from the flame spectrum, and that the strong triplet near M is not represented at all either in the arc or spark. The hydrogen-magnesium series of lines, beginning at a wave-length about 5210, are also seen sometimes, as already described by us (*Proc. Roy. Soc.*, vol. 30, p. 96), in the spectrum of the flame; but we have never observed that the appearance of these lines, or of the strong line with which they begin, is connected with the non appearance of b_4. Indeed, we can almost always see all three lines of the b group in the flame, though as b_4 is the least strong of the three, it is likely to be most easily overpowered by the continuous spectrum of the flame. The new observations recorded below leave, we think, no room for doubt that the series of lines beginning at wave length 5210 are due to a combination of hydrogen with magnesium, and are not dependent solely on the temperature.

The wave-lengths of the strong triplet near M are about 3720, 3724, 3730, and of the defined edges of the bands about 3750, 3756, 3765, 3772, 3777, 3782, 3790, 3799, 3806, 3810, 3815, 3824, 3841, 3845, 3848, 3855, 3858, 3860, 3865.

Burning magnesium in oxygen instead of atmospheric air does not bring out any additional lines; on the contrary, the continuous spectrum from the magnesia formed overpowers the line spectrum, and makes it more difficult of observation.

Magnesia heated in the oxyhydrogen jet does not appear to give the lines seen in the flame.

We have left out of the figure and from the enumeration of lines the well-known bands of the oxide.

Spectrum of the Arc.

By examining the arc of a battery of 40 Grove's cells, or that of a Siemens machine, taken in a crucible of dense magnesia under the dispersion of the spectrum of the fourth order, given by a Rutherford grating of 17,296 lines to the inch, we are able to separate the iron and magnesium lines which form the very close pair b_4 of the solar spectrum. Either of the two lines can be rendered the more prominent of the pair at will, by introducing iron or magnesium into the crucible. The less refrangible line of the pair is thus seen to be due to iron, the more refrangible to magnesium. Comparison of the solar line and the spark between magnesium points confirms this conclusion, that the magnesium line is the more refrangible of the two.

In the ultra-violet part of the spectrum photographs show several new lines. First, a pair of lines above U at wave-lengths about 2942, 2938·5. These lines are a little below a pair of lines given by the spark for which Cornu has found the wave-lengths 2934·9, 2926·7. The latter pair are not seen at all in photographs of the arc, nor the former in those of the spark. The strong line, wave-length about 2850, is always seen, very frequently reversed. Of the quadruple group in the spark to which Cornu has assigned the wave-lengths 2801·3, 2797·1, 2794·5, and 2789·9, the first and third are strongly developed in the arc, the other two not at all. Next follows a set of five nearly equidistant lines, well-defined and strong, but much less strong than the two previously mentioned, wave-lengths about 2782·2, 2780·7, 2779·5, 2778·2, 2776·9. The middle line is a little stronger than the others. The same lines come out in the spark.

Beyond these follow a series of pairs and triplets; probably they are triplets in every case; but the third, most refrangible, line of the triplets is the weakest, and has not in every case been noticed as yet. These succeed one another at decreasing intervals with diminishing strength, and are alternately sharp and diffuse, the diffuse triplets being the strongest. The series resembles in general character the sodium and the potassium series described by us in a former communication, and we cannot resist the inference that they must be harmonically related, though they do not follow a simple harmonic law. The most refrangible line in the figure at wave-length 2605 represents a faint diffused band which is not resolvable into lines; it belongs, no doubt, to the diffused members of the series, and, to complete the series, there should be another sharp group between it and the line at wave-length 2630. This belonging to the weaker members of the series is too weak to be seen.

The approximate wave-lengths found by us for these lines are as follows:—2767·5, 2764·5, 2736, 2732·5, 2731, 2698, 2695, 2693·5, 2672·5, 2670, 2668·5, 2649, 2646, 2633, 2630, 2605.

It is worthy of remark that the line at wave-length 5710, described by us in a previous comunication (*Proc. Roy. Soc.*, No. 200, p. 98), is very nearly the octave of the strong line at 2850. Moreover, the measures we have taken of the wave-length of this last line, with a Rutherford grating of 17,296 lines to the inch, indicate a wave-length 2852 nearly, which is still closer to the half of 5710.

---

* A Paper read before the Royal Society, May 12, 1881.

In Cornu's map of the solar spectrum a line is ascribed to magnesium with the wave-length 3278. Although a line at this place appears in many of our photograghs of the arc, we have not been able to identify it as a line due to magnesium. It does not show any increased strength when magnesium is introduced into the arc. When metallic magnesium is dropped into a crucible of magnesia or lime through which the arc is passing, the electric current seems sometimes to be conducted chiefly or entirely by the vapourised metal, so that the lines of other metals almost or wholly disappear; but the line at wave-length 3278 does not in such cases appear, though the other magnesium lines are very strongly developed. The line at wave-length 2850 is often, under such circumstances, enormously expanded and reversed, those at wave-lengths 2801, 2794, and the alternate diffused triplets, including those near L and near S, much expanded and reversed, and the group of five lines (2776—2782) sometimes reversed.

When the arc of a Siemens machine is taken in a magnesia crucible, the strong line of the flame spectrum, wave-length 4570, is well seen sharply defined; it comes out strongly and a little expanded on dropping in a fragment of magnesium. When a gentle stream of hydrogen is led in through a hollow pole, this line is frequently reversed as a sharp black line on a continuous background. From comparing the position of this line with those of the titanium lines in its neighbourhood, produced by putting some titanic oxide into the crucible, we have little doubt that it is identical with the solar line 4570·9 of Ångström.

When the arc is taken in a crucible into which the air has access, it may be assumed that the atmosphere about the arc is a mixture of nitrogen and carbonic oxide. When a stream of hydrogen is passed, either through a perforated pole or by a separate opening, into the crucible, the general effect is to shorten the length to which the arc can be drawn out, increase the relative intensity of the continuous spectrum, and diminish the intensity of the metallic lines. Thus, with a very gentle stream of hydrogen in a magnesia crucible, most of the metallic lines, except the strongest and those of magnesium, disappear. Those lines which remain are sometimes reversed; those at wave-length 2850 and the triplet near L being always so. With a stronger stream the lines of magnesium also disappear, the *b* triplet being the last in that neighbourhood to go, and b_1 and b_2 remaining after b_4 had disappeared.

Chlorine seems to have an opposite effect to hydrogen, generally intensifying the metallic lines, at least those of the less volatile metals, but it does not sensibly affect the spectrum of magnesium. Nitrous oxide produces no marked effect; coal-gas acts much as hydrogen.

Spectrum of the Spark.

In the spark of an induction coil taken between magnesium points in air we get all the lines seen in the arc except two blue lines at wave-lengths 4350 and 4166, two lines above U, and the series of triplets more refrangible than the quintuple group about wave-length 2780. The blue line wave-length about 4570 is best seen in the spark without a jar when the magnesium electrodes are close together, and the rheotome made to work slowly; and this and the other faint lines of the spark at about 4586 and 4808 require for their detection a spectroscope in which the loss of light is small.

On the other hand, some additional lines are seen. Of these, the strong line at wave-length 4481 and the weaker line at 4586 are well known. Another faint line in the blue at wave-length 4808* has been observed by us in the spark, and two diffuse pairs between H and the triplet near L. Two ultra-violet lines at wave-lengths 2934·9, 2926·7 (Cornu) are near, but not identical with, two lines of the arc above mentioned; and two more lines at wave-lengths 2797·1, 2789·9 (Cornu) make a quadruple group with the very strong pair conspicuous in the arc in this region. The spectrum of the spark ends, so far as we have observed, with the quintuple group (2782—2776) already described in the arc.

When a Leyden jar is used with the coil, some of the lines are reversed. This is notably the case with the triplet near L, the line at wave-length 2850, and those at 2801 and 2794. Cornu (*Comptes Rendus*, 1871) noticed the reversal of the less refrangible two lines of the triplet near L under these circumstances. This effect is very much increased by increasing the pressure of the gas in which the spark is taken. For the purpose of observing the influence of increased pressures, we have used a Cailletet pump and glass tubes similar to those employed in the liquefaction of gases by means of such a pump, but with an expansion of the upper part in which were magnesium electrodes attached to platinum wires sealed into the glass. The tube having been filled with gas at the atmospheric pressure, was sealed at its upper end, while the lower end dipped into mercury contained in the iron bottle of the Cailletet pump, and the gas was afterwards compressed by driving more or less mercury into the tube. The gases used were hydrogen, nitrogen, and carbonic oxide; and the image of the spark was thrown on to the slit of the spectroscope by a lens. In hydrogen, when no Leyden jar was used, the brightness of the yellow and of the blue lines of magnesium, except at first that at wave-length 4570, diminished as the pressure increased; while, on the other hand, the *b* group was decidedly stronger at the higher pressure. The pressure was carried up to 20 atmospheres, and then the magnesium lines in the blue and below almost or entirely disappear, leaving only the *b* group very bright, and the magnesium-hydrogen bands which are described below; even the hydrogen lines F and C were not visible. When a jar was used, the magnesium lines expanded as the pressure was increased; all three lines of the *b* group were expanded and reversed at a pressure of 5 atmospheres; the yellow line, wave-length 5528, was also expanded but not reversed; and the line at 4481 became a broad, very diffuse band, but the line at wave-length 4570 was but very little expanded. The expansion both of the *b* group and of the yellow line seemed to be greater on the less refrangible than on the more refrangible side of each line, so that the black line in those which were reversed was not in the middle. When the jar was used the pressure could not be carried beyond 10 or 12½ atmospheres, as the resistance became then so great that the spark would not pass across the small distance of about 1 millim. between the electrodes. At a pressure of 2½ atmospheres, with a jar, the ultra-violet magnesium triplet near L was very well reversed, and the two pairs of lines on its less refrangible side were expanded into two diffuse bands.

In nitrogen and in carbonic oxide the general effects of increased pressure on the magnesium lines (not the magnesium-hydrogen bands) seemed to be much the same as in hydrogen. Without a jar the blue and yellow lines were enfeebled, and at the higher pressure disappeared, while the *b* group was very brilliant but not much expanded. With the jar all the lines were expanded, and all three lines of the *b* group strongly reversed. The bands of the oxide (wave-length 4930—5000) were not seen at all in hydrogen or nitrogen; they were seen at first in carbonic oxide, but not after the sparking had been continued for some time.

The disappearance of certain lines at increased pressure is in harmony with the observations of Cazin (*Phil. Mag.*, 1877, vol. iv., 154), who noticed that the banded spectrum of nitrogen, and also the lines, grew fainter as the pressure was increased, and finally disappeared. When a Leyden jar is employed there is a very great increase in the amount of matter volatilised by the spark from the electrodes, as is shown by the very rapid blackening of the sides of the tube with the deposited metal, and this increase of the

---

* This line we first noticed in a former communication (*Proc. Roy. Soc.*, vol. 27, p. 353), but the wave-length is there given, through an error in taking out the ordinate of the curve of interpolation, as 4797 instead of 4807. Another measure has given the wave-length 4808.

amount of metallic vapour may reasonably be supposed to affect the character of the discharge, and conduce to the widening of the lines and the reversal of some of them. Without a jar the amount of matter carried off the electrode also doubtless increases with the pressure and consequent resistance, and may be the cause of the weakening, as Cazin suggests, of the lines of the gas in which the discharge is passed. It is to be noted, moreover, that the disappearance of the hydrogen lines depends, in some degree, on the nearness of the electrodes. The lines C and F, which were, as above stated, sometimes invisible in the spark when the electrodes were near, became visible, under circumstances otherwise similar, when the magnesium points had become worn away by the discharge.

M. Ch. Fievez (*Bull. de l'Académie Royale de Belgique*, 1880, p. 91) has investigated the variations in the appearance of the spark spectrum of magnesium under certain different conditions. Using a Rutherford grating of 17,296 lines to the inch, he has noticed certain lines about the *b* group which increase in number with the order of the spectrum observed. He has also noticed dark lines in the solar spectrum corresponding to these lines of magnesium when the two spectra were superposed. We have noticed similar lines in the spectrum of magnesium given by a Rutherford grating, but attribute them to a different cause. The Rutherford gratings have a periodic inequality in the ruling, due to an imperfection of the screw of the ruling machine, in consequence of which the image of every bright line is accompanied by a series of fainter images at nearly equal distances on either side of it, diminishing rapidly in brightness as they recede from the principal line. These *ghosts* are so much fainter than the principal lines that they are not noticed in the case of any but bright lines, and except in the case of very bright lines only two, one on each side, are seen to accompany each principal line. The positions of these *ghosts* have been investigated by Mr. Pierce in the *Mathematical Journal*, of the Johns Hopkins University, Baltimore, who has found theoretically, and confirmed it by actual observation, that the distance between successive images of the same line is directly proportional to the dispersion and inversely as the order of the spectrum. Our own observations of the positions of the *ghosts* of the *b* group of magnesium lines in spectra of different orders agree closely with Mr. Peirce's theory, and two different Rutherford gratings both give us the same results. The annexed diagram gives the relative positions of the first pair of *ghosts* of each of the lines of the *b* group in the spectra of the third and fourth orders, when the angle between collimator and telescope is 45°. If this is compared with M. Ch. Fievez's map, it will be seen that he has probably been deceived by these *ghosts*, both in the solar spectrum and in that of the spark; but as he does not state the angle between his collimator and telescope, no exact comparison can be made. These ghosts are sometimes very embarrassing when many lines are in the field of view, but they may be detected by comparing the spectra of different orders, as the ghosts have different relative positions in the spectra of different orders. In the spectrum of the third order the first ghost of b_2 on the more refrangible side falls on b_4, and that of b_4 on its less refrangible side falls on b_2.

(To be continued.)

Chromous Bromide and Iodide, and Chromous Oxalate.—H. Moissan.—The author obtains anhydrous chromium bromide by reducing chromic bromide by hydrogen, by the action of dry hydrobromic acid at high temperatures upon fused chromium, and by passing vapours of bromine in a current of nitrogen over metallic chromium heated to redness. The iodide is obtained by similar methods, and the oxalate is formed by the action of oxalic acid upon chromous acetate in an atmosphere of carbonic acid, freed from oxygen.—*Comptes Rendus.*

ON THE
VENTILATION OF HALLS OF AUDIENCE.*

By ROBERT BRIGGS,
Member of the American Society of Civil Engineers.

(Continued from p. 254.)

Aqueous vapour (which is merely the accepted name for steam in its invisible condition below the boiling-point of water) is, like carbonic acid, an innocuous gas, quite harmless to animal life, except in so far as its presence in large proportions interferes with the natural secretions.

It would almost seem, from these statements as to the harmless character of respired gases, that the word "vitiated" was misapplied to exhaled air.

There is present in air, in general, a certain amount of gaseous impurities. Ammonia, sulphuretted hydrogen, and sulphurous acid gas, with numerous others of local derivation (especially near towns or cities), are found in very small quantities; so small that the hundredth of a per cent is to be taken as a unit in measuring them. But besides these gaseous impurities, there always exists in air of inhabited regions very small quantities of floating organic matter, composed of fragments of organic origin, vapours of the same source, like odours, for instance, microscopic germs or living organisms, together with dust of minerals, metals, smoke, &c., forming an insignificant part of the atmosphere, nearly inappreciable by weight or measure, but of the greatest importance in effect upon the air of ventilation.

The dangerous vitiations of air by respiration or by perspiration are those which proceed from the decomposable organic matter, exhaled or emitted. This organic matter appears to be carried to a large extent by the aqueous vapour, although much of it exists as floating dust; and small particles of skin, fatty substances, and bits of hair can be caught and identified by the microscope. The quantity of such organic matter is exceedingly diminutive as compared with any given volume or weight of air. Dr. Angus Smith (the only authority, but his authority is sufficient) concludes that not the one hundred-millionth part of its volume for pure air on high ground, or about the one five-millionth part in a crowded railway-carriage, is organic impurities. Yet to a very small portion of this very small portion of air is attributed the danger from breathing vitiated air. In all probability the origin of disease can be found only in atmospheric germs of living organisms, which find the perpetuation of their vitality in the decomposable and decomposing organic matter suspended in the atmosphere, and which are disseminated through the agency of the same atmosphere.

The quantity of carbonic acid exhaled in a given time by any number of persons is nearly uniform, and also the proportion in free air is quite uniform, so that the proportion of carbonic acid present in any occupied room can be taken to represent very accurately the degree of vitiation from respiration. Not that the carbonic acid itself is dangerous or unhealthy; but by its presence in excess of the normal quantity the organic matter proceeding from persons occupying the room, and the related unhealthiness, can be estimated. The measure, however, is not a positive one, as a relationship to the degree of moisture in the air of any room is one of the conditions of the decomposition of organic matter, so that vitiated air laden with moisture may be considered more dangerous than the same air comparatively dry, and this regardless of the carbonic acid present.

This very long preamble to the real subject of this paper has been made because the writer felt it necessary to substantiate fully his fundamental propositions as to the absolute and demonstrable quantities of air needed for ventilation.

So far as carbonic acid and vitiations proceeding from

---

* A paper presented to the American Society of Civil Engineers, January 26, 1881.

the breath are concerned, it is evident that only a little over one-third of a cubic foot of pure air is needed each minute, provided the entire volume of vitiated air be removed without mixture in the same time. So far as moisture or aqueous vapour emitted is concerned, about 4½ cubic feet per minute, supplied at 70 degrees and of 70 per cent of humidity, will suffice to prevent the deposition, if the air be evacuated at 70 degrees and in the condition of saturation; while if it be admitted that the effluent vitiated air of the room has a temperature of 72½ degrees, its condition of humidity when carrying the same amount of vapour will be only 90 per cent. Whence 4½ cubic feet of air per minute (under these conditions of supply) is enough to remove all vitiated air from personal sources, to furnish perfectly fresh, pure air for respiration, and to provide an *atmosphere* 4 or 5 inches thick around a standing individual, which *atmosphere* will ascend around him, and be supplied from beneath, at the rate of motion of about 3 or 4 feet per minute.

This proposition for the absolute ventilation of an individual has been stated in all its baldness to make its impracticable character emphatically evident. Men are not going to be ventilated in cases, even to secure perfectly fresh and healthful air. The purity of air in any occupied place can only be relative. The sole mode of removal of vitiated air possible is by diffusion and dilution. A much larger quantity of air will have been supplied or permitted to enter into a room, and will be removed or allowed to escape, than is needed for the use of the persons occupying the room, during the time of their occupancy of the same; and the room itself will have a definite cubical capacity, and form an intermixing chamber for the fresh and vitiated air.

We have now passed all exact computation, and come into a field of guesses and assumptions. With a definite supply of air to any room (which supposes in some way a corresponding efflux) a certain quantity of exhalations and emissions will eventually approximate to a definite ratio of the constituent parts of the air within the room. If it be supposed that twice the quantity of carbonic acid is admissible in a continuously occupied room, over that existing out of doors in fresh air, then ninety-five times as much air as is needed for respiration, &c., must be supplied to dilute the exhaled air,—a proportion which gives about 32 cubic feet of air per person per minute, with a result of 0·0008 volume of carbonic acid present. If it be supposed that the hygrometric condition of the air is limited to an *increase* of 5 per cent of the humidity in air of 70 degrees, then the absorption of vapour demands 25 cubic feet of air to each person per minute. These neat results from computation would be very satisfactory if there were any grounds for the assumption of 8 parts in 10,000 as the exact ratios for carbonic acid and air in rooms, or for acceptance of 5 per cent of humidity in place of some other ratio, smaller or larger.

The whole matter, then, resolves itself into opinions as to individual personal comfort, and to observations upon healthfulness of some of the very few rooms and places where, for a period of time, more or less extended, a definite ventilation has been maintained.

It seems pretty well established, for rooms continuously occupied by persons, either in good health or at least not subject to offensive disease, that 30 cubic feet of air per person per minute, if of proper temperature and humidity (temperature and humidity being considered to have related values), and if adequately introduced and removed into and from rooms which have a cubic capacity of not less than 1000 cubic feet per person, will pleasantly, healthfully, and satisfactorily ventilate such rooms.

When one considers the various conditions comprised in this rule, he will comprehend how generally inapplicable the fixed rule of 30 cubic feet per person per minute becomes. The condition of the persons as to health, &c., will change the figures from 30 to 60 for surgical or obstetrical wards in hospitals; while for some diseases even the larger quantity will not remove offence, and for yet others no quantity of air can be named sufficiently large. Increase of temperature and humidity, for degrees and percentages above 70 degrees and 70 per cent of humidity, begin to demand larger quantities of air for comparative comfort; with 90 degrees out-of-doors, and 60 to 70 per cent of humidity, even 60 feet per minute is not an excessive quantity of air, where 30 is named above.

The continuity of occupancy and cubic capacity are in some respects interchangeably related values. Where any room is to be occupied for a short time only, its cubic contents may be taken as so much fresh air, and deducted from the amount of air required for ventilating the same room for the same time. Thus let it be supposed the room itself has the cubic contents of 1800 feet; that one person alone occupies this room for an hour (supposing it to have been filled with fresh air at the commencement of the time), and that no fresh air is supplied during the hour; the degree of vitiation will only have reached the point which would, eventually, have been attained in a continuously occupied room, where 30 cubic feet of air had been regularly supplied each inmate. This almost self-evident proposition is of the highest importance in ventilation. The homes of those in humble circumstances, and even of those who live in moderate ease, are made healthful, not by abundant constant supply of fresh air, but by frequent freshenings of the air of dwelling or sleeping rooms. No systematic ventilation, however well devised and constructed, however extensive its supply of fresh air, however regularly or judiciously operated, can afford to dispense with repeated displacement of the air of rooms, and substitution of entirely fresh air through open windows and doors, at times during all seasons of the year. This law of change of air, taken in connection with a limited supply during time of occupancy, applies directly and at once to the halls of audience, the ventilation of which is the theme of this paper.

In all civilised countries people congregate in churches, halls, or theatres, for devotion, instruction, or amusement. The ends of government require legislative and council chambers, and court rooms, which have at times crowded sessions. There are thousands of rooms in this land, and in other countries, in which crowds are gathered, and often packed for sessions of one to six hours on the average, with occasional sessions, in some legislative halls in particular, of twelve and sometimes more than twenty-four hours. Anything may be called tolerable that is tolerated, anything may be esteemed endurable that is endured. Churches, halls, schools, theatres, state houses, court rooms, &c., are rendered tolerable when judicious care is taken in changing the air after a session, and in having fresh air in the audience rooms at the commencement of the same. They are endurable—not only can little illness or actual disease be traced to them as places of origin, but on the whole the audiences, accustomed or habituated to the closeness of the air which accompanies any lengthened session, cease to notice what would be excessively disagreeable to a new-comer into the confined room. People do not willingly find fault where there is apparently no remedy.

Perhaps the most striking example of this salutary effect of occasional change of air as a substitute for ventilation by constant supply, is to be found in our American railroad cars, where, in cold weather, the least of regular supply is furnished to largest number of persons temporarily crowded into the smallest space. To the outsider the heat becomes intolerable; to the insider it is more tolerable than any draft of fresh, cold air.

To the chemist, the air is found "vitiated" to the extreme, both with carbonic acid and with vapour of water, while it is laden with organic impurities that are hastening towards the condition of offensive decomposition. The unhealthful condition of the air in thousands of cars, on any day during six months of any year, cannot be questioned. And yet no serious illness that can be attributed to the want of ventilation is found amongst the tens of thousands of passengers, and it is well known that the conductors, brakemen, and others connected with the trains, who live in and out of the cars from day to day, are healthy beyond the healthiness of most other men.

Comfort is found in warmth. Whatever supply of fresh air be given, not the slightest sensation of cold must be appreciated from the current of fresh air by any occupant of a room. There is only one exception to this dictum, and that is when a person, having come to a sense of oppression from the air of a room (a sense which is almost invariably one of heat and not of badness), voluntarily endures the admission of fresh cold air upon himself. Such a person will be more likely to enjoy a blast from an open window when the external air has the temperature of zero, than to endure a gentle current of 4 or 5 feet per second, of air at 60 to 65 degrees, and 45 to 50 per cent of humidity. The requirements of ventilation are not positive. Those of comfortable warmth are immutable facts. The air of any room may have become much vitiated, and even offensive, and if its temperature be kept down to the point of comfort most persons will deem such air to be fresh within the desirable degree of purity, while an overheated room is apt to be pronounced to be "filled with bad air," although the air may be as pure as is attainable.

The popular appreciation of ventilation is founded upon effluvia and heat. Effluvia may proceed from two sources: first, from the decomposition of organic matter exhaled or emitted (a very short time is needed for this decomposition to become apparent); and second, from odours which emanate from the person or clothing of those occupying a room, whether the odour be offensive or defensive. In either case effluvia, when marked as pervading a room, or any portion of it, is a legitimate evidence of inadequate ventilation. The effect of odours, however, on the senses is very imperfectly marked. A habitude is established, and nine persons out of ten of an audience do not realise the degree of vitiation which has been reached by gradual steps during a session, and at the end of the same, when passing to the outer air, the change of temperature will not allow the change of quality to be perceived. Unless one has had occasion to enter the hall during the sitting he will never know the air had become impure. Heat becomes, therefore, almost the sole standard by which ventilation of halls is judged. The overheated condition, especially of the upper portions of halls, obtains the designation of closeness, and is generally submitted to the limit of endurance, at which point some window near by is opened, greatly to the discomfort, in cold weather, of those on the floor of the hall, and little to the relief of the overheated portion of the room.

Except in very cold weather crowded halls do not require the supply of much heat. Many halls, with corridors and passages on one, two, or all sides, especially auditoriums of theatres, require no more than to be warmed to a comfortable temperature before the audience collects, after which the heat from the persons composing the audience will more than supply what heat is lost at the windows or walls. For ventilating a hall in such case it becomes necessary to introduce air of lower temperature than that of the room. The problem, then, is how to introduce and distribute cold currents of air amongst a crowded audience without producing the sensation of cold to any one of them.

The air supply demanded may not be strictly cold. Its desirable temperature may rise considerably above the proper temperature of the room, and yet it will, in currents, be perceptibly and sensibly cold.

The feeling of cold from currents of air proceeds from two sources. First, the abstraction of heat in warming the air itself; and second, from the absorption of vapour by the air, which vapour will have been formed at great expenditure of heat from the natural moisture of the skin. "The quantity of heat taken up in the vaporisation of the moisture of the skin by dry and cold air, compared with that abstracted in warming the air, is so great that the heat imparted to the temperature of the air becomes much the least in the ratio. Thus air at 35 degrees and of 70 per cent humidity demands nearly the same quantity of heat, to warm it to 70 degrees, that is requisite to vapourise the moisture which will raise the humidity to 75 per cent at 70 degrees.* It is very nearly correct to assert that the cool sensation from a breeze in summer proceeds entirely from the evaporation of moisture thereby induced. A current of saturated air at 100 degrees will neither remove heat by contact nor by induced evaporation, and is consequently incapable of producing a cooling effect; while as the temperature or the degree of humidity is supposed to fall, the same velocity of current becomes first a pleasant, cooling one, and next a decidedly cold one. With a high temperature and dry air the cooling effect of a current (even at 100 degrees) may be pleasant to the sensation, but will be attended by sun-burning (even without exposure to the sun), and blisters will be produced by the excessive deprivation of moisture, from the cuticle or surface of the skin. With 80 degrees of heat and a high dew point, a strong breeze is not unpleasant, nor likely to be injurious, after the person shall have acquired some accustomed habit of body to endure it; but at 70 degrees and a low dew point, which is the only possible condition of heated air in mid-winter, the annoyance of a current of even 5 feet per second and its unhealthiness are positive facts." †

It is proper that I should advert, at this point in my discussion, to the marked differences of the variations and requirements of warming and ventilating that exist in this country from those which are found in England or France. The subject has been considered in the Paper "On the Relation of Moisture in Air to Health and Comfort," but it may be now again referred to, in support of the view that American practice should be directed to meet the special requirements of American conditions, and not to conform with other requirements, however well established in themselves. As was set out in the Paper "On Moisture in Air," it seems at first inexplicable to an American how the statement can be made by foreign writers that 56° to 62° F. are comfortable temperatures for living rooms, when in cold weather he is scarcely warm at 70 degrees, and in mid-winter is not overheated at 80 degrees, although clad at the time in the thickest of under-clothing. The fact is that the deprivation of heat from the person is greater from the evaporation of moisture than from radiation or convection of the air, and the hygrometric state of the atmosphere has so much influence as to make a temperature of 56 degrees in Ireland, the West and South of England, or in Normandy, sensibly as warm as 80 degrees in Canada or Minnesota, at about the same season of the year.

All mankind complain of the weather, and an Englishman especially. But there are in England eight months of the year when the thermometer ranges between 40 and 60 degrees in the shade (and there is very little sunshine), with a dew point so high that it is a pleasure to exercise in the invigorating air; one month of 60 to 80 degrees; and three months from 25 to 50 degrees: while in Northern America there is scarcely one month (or thirty days) with the average temperature of 50 to 70 degrees (temperatures which, from the difference of humidity, correspond sensibly to 40 to 60 degrees in England), and there are about three months from 75 to 90 degrees, three months of 30 to 50 degrees, and five months of excessive variation of temperatures from zero to 40 or 50 degrees, these last five months having about thirty days of warm weather at intervals. During the three hot months, and also during the five cold ones, open-air exercise to those whose avocations are generally within doors is almost impossible. Anyone who is called upon to endure the fervid summer heat, or who will habituate himself to the inclemencies of

---

* *Vide* Addenda to Paper "On the Relation of Moisture in Air to Health and Comfort," which will be reproduced in a future number of the Chemical News.

† Quoted from a Paper by the author, "On the Ventilation of the Hall of Representatives, Washington," 1876.

our Arctic winter, will not suffer great discomfort therefrom; but the weak and the tender, the workman of the factories, the tradesman of the shops, the merchant in the counting-house, the student at the desk, cannot acquire the endurance or the habit, and must shelter or warm themselves.

It follows that the ventilation of halls in England for eight months of the year is simply the quiet introduction of a given quantity of external air, little or no increment of heat being necessary; and for three-twelfths of the year the similar introduction of air, heated 15 to 20 degrees. There is one month of altogether open windows; but, except on a few stormy days, there are few times when relief from overheat or closeness in a room cannot be obtained without serious discomfort, by partial or controlled admission of external air directly from windows. The small addition of heat demanded at any season, and especially for the most of the year, prevents the adoption of our system of ventilation by means of warmed currents of air. The use of the levity of the entering current ceases to be available when that current must necessarily be only very little, if at all, higher in temperature than the room itself. On the other hand, the operation of an exhaust system, where an exhaust shaft or fan is made to remove air from the room, becomes eminently feasible, when the general conditions are such that the outer air may be taken in freely, at any provided or arranged inlet, without discomfort from its want of heat. The great support of the exhaust system for American usage is derived from English authority and example, together with its applicability to ventilation for the American single month of the year, of 50 to 70 degrees, when closed windows and a supply of unheated air is the requisite for occupied places.

Our season of open windows is longer than that of England, but it is also much hotter, and we are constrained to some forced supply of air during the hot season to render audience halls tolerable. Our term of mean temperature is so brief that its especial consideration may be neglected for audience halls, but for asylums or hospitals this term must be adequately provided for. The real point of discussion is how to warm with an average temperature outside of 25 to 30 degrees to the inside temperature of 70 to 75 degrees, and how to supply, with the warming, sufficient air for breathing and for the preservation of relative purity.

There are two respects in which ventilation of halls becomes easier in America than in England. The greater humidity of the English climate prevents the dispersion of exhaled vapour with the same rapidity as with us, and exhaled vapour is laden with organic impurity on the verge of decomposition. Only a very few minutes are required for surcharged air at the temperatures usually existing in close rooms to become offensive. The fœtor of a long-occupied hall in England is distinctive to an American, and unapproachable in a drier climate. In another regard we have, in the court rooms, theatres, and public buildings in general in America, the advantage of superior cleanliness in dress and person for a considerable portion of the audiences. We have comparatively no lower order to ventilate against.

(To be continued.)

ON MANGANESE IN STEEL.

By SERGIUS KERN, M.E., St. Petersburg.

Many works using inferior materials for the production of cast-steel, either by the Bessemer or open-hearth processes, add a notable quantity of spiegeleisen, or ferro-manganese; in steel cast by such works, some 0·60 to 1·00 per cent of manganese is often detected. Certainly, such a steel is good for many purposes, but in some cases (as for the preparation of plates for boiler-making and ship-building) it is a serious question if it is proper to use such a material, the corrosive property of which is very high and bending tests bad. The author believes that inspectors, before passing plates for the above-mentioned purposes, should be instructed to make acquaintance with the chemical composition of the steel; by such means much confusion may be avoided.

Some Bessemer steel plates for boilers, on being analysed, gave the following results:—

Carbon	0·18 per cent.
Manganese	0·65 ,,

The ingots for the manufacture of these plates, rolled capitally well, and stood a higher heat than Siemens-Martin ingots containing:—

Carbon	0·18 per cent.
Manganese	0·24 ,,

But in respect to the bending tests, these Bessemer and Siemens-Martin plates behaved quite differently, plainly showing the hardening effects of manganese:—

A.—*Bessemer Plates.*

Specimen re-heated and cooled in sand	Bent double.
Specimen heated to a yellow heat and cooled in water	Broke at a bend of 25°.

B.—*Siemens-Martin Plates.*

Specimen re-heated and cooled in sand	Bent double.
Specimen heated to yellow heat and cooled in water	

It must be added that the contents of silicon, sulphur, and phosphorus were, on the average, nearly the same, both in Bessemer and Siemens-Martin steel.

LONDON WATER SUPPLY.

Report on the Composition and Quality of Daily Samples of the Water Supplied to London, from April 20th to May 19th, 1881.

By WILLIAM CROOKES, F.R.S.,
WILLIAM ODLING, M.B., F.R.S., F.R.C.P.,
Professor of Chemistry at the University of Oxford;
and C. MEYMOTT TIDY, M.B., F.C.S.,
Professor of Chemistry and of Forensic Medicine at the London Hospital; Medical Officer of Health for Islington

To the Right Honourable the President of the Local Government Board.

May 20th, 1881.

Sir,—Herewith we submit for your consideration the results of our daily examinations of the water supplied to the Metropolis by the seven London Water Companies deriving their supply from the Rivers Thames and Lea for the month ending May 19th.

We have as heretofore taken every care to obtain trustworthy samples of the water delivered from the mains of the several companies. The places and times at which the samples were collected are duly stated in the tables.

The waters generally have shown a continued improvement during the past month, and have reached, somewhat earlier in the year than usual, a condition (so far as the presence of organic matter is concerned) of extreme purity.

In 9 only of the 182 samples examined were we able to detect the minutest trace of matter in suspension. The colour of the waters, as seen in the two-foot tube, has been daily determined by the process described by us in a former report. It has been as nearly as possible of the tint of distilled water throughout the whole month.

In Table I. we have recorded the analyses in detail of samples, one taken daily between April 20th and May 19th. The purity of the water in respect of organic matter has been determined by the Oxygen and the Combustion processes, and the results of our analyses by these methods are stated in columns XIV. to XVIII.

In Table II. is recorded the colour together with the clearness or turbidity of each sample. Of the 182 samples collected by us between the dates mentioned above, 173 were found "*clear*," and 9 were noted as "*very slightly turbid*."

Of the 26 samples supplied by the New River Company, 1 was found to be "very slightly turbid." The remaining 25 samples being clear, bright, and efficiently filtered.

Of the 26 samples from the mains of the East London Company, 4 were noted as "very slightly turbid." The remainder were bright, clear, and well filtered.

Of the 26 samples from the mains of the Chelsea Water Company, the whole were bright, clear, and well filtered.

Of the 26 samples from the mains of the West Middlesex Company, 2 were found "very slightly turbid." The remainder were clear, bright, and well filtered.

Of the 26 samples from the mains of the Lambeth Water Company, 2 were found "very slightly turbid." The remainder were clear, bright, and well filtered.

Of the 26 samples from the mains of the Grand Junction Company, the whole were clear, bright, and well filtered.

Of the 26 samples from the mains of the Southwark and Vauxhall Company, the whole were clear, bright, and efficiently filtered.

When a trace of suspended matter is noticeable, we record the water as "turbid." When on close scrutiny we are able to detect any suspended matter whatever, we call the water "very slightly turbid." A water is recorded as "slightly turbid" when we consider it to come between those two extremes.

In Table III. we have recorded the oxygen required to oxidise the organic matter, and the quantities of free oxygen in the whole of the samples collected.

The waters supplied during the month have been uniformly clear, bright, and almost colourless, proving that they have been well and efficiently filtered.

Examined chemically they have shown excellent aëration and great freedom from organic matter. They leave nothing to be desired for dietetic purposes.

We remain, Sir,
Your obedient Servants,
William Crookes,
William Odling,
C. Meymott Tidy.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, June 2, 1881.

Prof. H. E. Roscoe, President, in the Chair.

The following certificates were read for the first time:—W. Rupp, J. D. Custance.

It was announced that a ballot for the election of Fellows would be held at the next meeting (June 16).

The following papers were read:—

"*On the Action of Solvents on Saponified Oils and Waxes*," by A. H. Allen and W. Thomson. No satisfactory process at present exists for the analysis of mixtures of hydrocarbons with animal and vegetable fatty matters, although a correct determination is often of considerable practical importance. The process at first adopted by the authors is as follows:—10 grms. of the sample are weighed out into a 5" evaporating dish, 50 c.c. of an 8 per cent solution of caustic soda in absolute alcohol added, and the whole gently boiled with stirring until frothing occurs. 15 c.c. of methylated spirit should now be added, and heat applied till the saponified oil is dissolved. 5 grms. of sodium bicarbonate are then gradually added with constant stirring, and lastly 50 to 70 grms. of clean ignited sand are stirred in. The whole is then dried for twenty minutes in the water-oven. The mixture is transferred to a large test-tube, having an aperture at the bottom plugged loosely with glass-wool. The tube is placed in a Xoxhead's fat extractor (a rather larger size than that usually made) adapted to a small tared flask containing 100 c.c. of petroleum spirit (boiling below 80°). When the extraction is complete, the petroleum spirit is distilled off, and the dry residual matter weighed. By using this process the authors obtained the following percentages of unsaponifiable matter:—Lard, 0·23: olive oil, 0·75; German rape oil, 1·00; cotton seed oil, 1·64; cod-liver oil, 1·32 and 0·46; sperm oil 39·14 and 51·31; spermaceti, 40·64; bees'-wax, 52·38; Carnauba wax, 54·87; Japan wax, 1·14; rosin oil, 98·72; mineral lubricating oil, 99·90. In the case of the cod-liver oil, the unsaponifiable matter contained cholesterin. With spermaceti and the waxes this matter left a sensible proportion of ash, doubtless because the solution of melissyl or cetyl alcohol in petroleum spirit acted as a solvent for sodium soaps. The authors tried to avoid this inaccuracy by forming calcium and magnesium soaps, but without success. They also investigated the action of various solvents on the sodium soaps from various oils. They found, too, that the hydrocarbon oils, when present in quantity, exercised a similar solvent action; so that while the process above described gives accurate results with unmixed animal or vegetable fats, and with unmixed hydrocarbon oils, with mixtures of the two classes the method was unreliable. In such cases they recommend the following:—5 grms. of the sample are treated in an evaporating dish with 25 c.c. of alcoholic soda, and the mixture boiled until it froths. 50 c.c. of warm water are added to dissolve the soap, and the solution transferred to a globular glass separator of about 200 c.c. capacity, furnished with a tap below and stopper at the top. The basin is rinsed out with 20 to 30 c.c. of water, and then 30 to 50 c.c. of ether added. The whole is then thoroughly mixed. The separation of the ether can be hastened by cooling or by the addition of a few c.c. of alcohol. The soap solution is run off, the ether washed, and the washings drained off. The etherial solution of the unsaponifiable matter is then run into a tared flask, and distilled to dryness. The soap solution must be agitated a second and third time with ether if great accuracy is required. In order to test the accuracy of the process the following mixtures were analysed:—

Mixture.		P.c. of Mineral or Resin Oil.	Found Per cent.
Olive and shale oil	..	60	58·028
,, ,, ,,	..	20	19·37
Olive and resin oil..	..	60	53·05
		60	59·42
		20	19·61
Lard and paraffin wax ..		40	40·48

The authors promise further investigations on the higher alcohols from the waxes, and also an examination of the products of the saponification of Japan wax.

"*Experimental Researches on the Amalgamation of Silver Ores*," by C. Rammelsberg. The author gives the results of many quantitative experiments as to the reactions which take place in the Mexican amalgamation process. He has investigated the actions of cupric and cuprous chlorides on silver, silver chloride, silver sulphide, arsenic sulphide, antimony sulphide, and on complex combinations, particularly sulpharsenide and sulphantimonide of silver.

"*On the Sulphides of Copper, and a Determination of their Molecular Weights*," by S. U. Pickering. The cupric sulphides were prepared by precipitation by hydrogen sulphide, and by heating electrotype copper with strong sulphuric acid at 180° C. for thirty minutes; the cuprous sulphides by heating pure copper with strong sulphuric acid at 124° for thirty minutes, and by partial reduction of cupric sulphide in a current of hydrogen. The author has investigated the action of hydrogen and carbonic anhydrides on the sulphides, and has also heated the sulphides alone. When cupric sulphide is heated in a slow current of hydrogen, hydrogen sulphide begins to be evolved at about 200° C., and between that temperature and 265° the cupric is converted into cuprous sulphide. On raising the temperature no further reaction is noticed until a red-heat is nearly reached (580° to 650° C.), when the whole is reduced to the metallic state. Cupric sulphide, when heated in a current of carbon dioxide, exhibits similar phenomena. At 130° to 150° cuprous sulphide is formed; at 230°, metallic copper. When cupric sulphide is heated to a sufficiently high temperature in a gas which has no reducing action upon it, half the sulphur is evolved, and cuprous sulphide is left. As the sulphur is obviously eliminated in two distinct steps, the author concludes that the formula of cupric sulphide must be doubled, and is therefore Cu_2S_2.

Dr. Armstrong, while admitting the extreme probability of the view suggested by Mr. Pickering, did not think that the fact that the sulphur was given off in two steps was quite sufficient proof that the formula should be doubled.

Mr. Pickering said that the only other explanation was that part of the sulphide was reduced to metallic copper, which immediately combined (at such a low temperature) with another portion of unaltered cupric sulphide. This seemed to him very improbable.

The next paper was read by Mr. J. C. Thresh, and was entitled "*Chemical Examination of the Buxton Thermal Water.*" The author first had his attention attracted by the extraordinary statement of Playfair that this water contains 206 cubic inches of nitrogen gas per gallon. Muspratt increased the quantity to 504 cub. inches. The author has repeated these determinations, but could only find about 22 c.c. of N per litre. The erroneous results of Playfair and Muspratt seem to have been obtained as follows:—The gas which is found over the spring contains N 98·98 per cent, CO_2 1·02. They estimated the CO_2 in the water, and assumed that the same proportion existed between the gases dissolved in the spring as was found in the gases evolved by the water. They completely overlooked the fact of the greater solubility of CO_2 in water. The gases dissolved in a litre of water are 22 c.c. N and 14·5 c.c. CO_2. The mean composition of the gas dissolved in the water is therefore 59·78 per cent N, 40·23 CO_2, which, by calculation from the coefficients of absorption of CO_2 and N, should evolve a gas containing 99·12 per cent N, 0·88 per cent CO_2. The author gives details of the method employed by him in collecting and analysing the gas. He has also made a complete mineral analysis of the mud deposited by the spring: it contains 71·1 per cent Mn_3O_4, 1·08 per cent of matter insoluble in HCl, 0·02 per cent molybdic acid, 0·30 per cent cobalt oxide, 5·3 per cent lime, 1·36 per cent iron and aluminium oxides. The presence of the molybdic acid was confirmed by the yellow precipitate with sodium phosphate, &c. The author suggests that the large quantity of nitrogen may be accounted for by supposing the water to have been at one time saturated with air from which the oxygen has been removed by the lower oxides of manganese.

Mr. Thomas said that a spring near Cardiff similarly evolved a large quantity of nearly pure nitrogen. In this case he had traced the nitrogen to a shale containing large quantities of that gas.

The President then exhibited some specimens illustrating the synthetical production of indigo by Baeyer, also a magnificent specimen of isatin lent by Dr. Schunck.

The Secretary then read a paper by E. J. Mills "*On Potable Waters (Part II. Determination of Total Solids).*" The author suggests that this determination should be made by accurately observing the time which a glass bulb takes to rise through a measured depth (22 centimetres) of the water. Care must be taken that all the surfaces are clean and that the temperature is constant. The time was taken by a metronome beating thirds of seconds. This method determines every constituent that is foreign to distilled water.

The following paper was also read by the Secretary: "*On the Estimation of the Value of Zinc Powder, and on a Gauge for Measuring the Volume of Gases without Calculation for Temperature and Pressure,*" by J. Barnes. The value of the zinc powder was estimated by the amount of hydrogen evolved. The hydrogen is measured by the quantity of water which it displaces. The gauge consists essentially of a narrow graduated tube placed in mercury; on the upper end of the tube a bulb is blown. The value of the graduation is determined. On exposing this bulb to the temperature and pressure at which the gas is being measured, reading off the division at which the mercury inside and outside is level, and referring to a table, a number is obtained. The observed volume of the gas is divided by this number, and the corrected volume at once obtained.

The Society then adjourned to June 16, when a ballot for the election of Fellows will be held and the following papers read:—"On the Isomeric Acids Obtained from the Ethers of Salicylic Aldehyd and from Coumarin," by W. H. Perkin; "Notes on Naphthalene Derivatives," by H. E. Armstrong; "On the Synthetical Production of Ammonia," by G. S. Johnson; "On the Sulphates of Aluminium," by S. Pickering.

ROYAL INSTITUTION OF GREAT BRITAIN.

General Monthly Meeting, Monday, June 6, 1881.

George Busk, Esq., F.R.S., Treasurer and Vice-President, in the Chair.

C. J. S. Spedding, Mrs. Katharine Maria White, and Captain Henry Tryon Wing were elected Members of the Royal Institution.

The special thanks of the members were voted to Mr. William Ladd for his valuable present of a dynamo-magneto-electric machine and platinum wire apparatus.

The presents received since the last meeting were laid on the table, and the thanks of the members returned for the same.

AMERICAN CHEMICAL SOCIETY.*

May 6, 1881.

Prof. A. R. Leeds in the Chair.

In the absence of a quorum, the regular business was deferred till one should be present.

The first paper of the evening, "*On a Slight Modification of the Wilkinson Gas Eudiometer,*" was then read by James H. Stebbins, Junr., S.B. The modification described consisted in having the glass stopcock soldered directly on the top of the eudiometer, instead of the long thin neck previously used.

Some remarks were then made by Prof. Doremus, after which the second paper of the evening, "*On the Purification of Baric Sulphate,*" by T. O'C. Sloane, Ph.D., was read.

The third paper of the evening, "*On a Qualitative Test for Carbon Disulphide and Carbon Dioxide in Coal Gas,*" by T. O'C. Sloane, Ph.D., was then read.

The Recording Secretary then announced that a quorum was present. The minutes of the previous meeting were read and approved.

Some discussion then followed, participated in by Messrs. Squibb and Casamajor, after which, the minutes of the previous meeting of the Board of Directors was read and approved after a small correction.

---

* Communicated by James H. Stebbins, Junr., Recording Secretary.

The following gentlemen were then unanimously elected:—C. P. Sawyer, Associate Member; proposed by Arthur H. Elliott, Elwyn Waller, P. Casamajor. A. Howard Van Sinderen, Associate Member; proposed by Arthur H. Elliott, T. O'C. Sloane, J. B. F. Herreshoff. Dr. Otto Grote, Member; proposed by S. A. Goldschmitt, Bernard G. Amend, James H. Stebbins, Junr. J. G. Mattison, Member; proposed by P. de P. Rickets, Arthur H. Elliott, C. F. Chandler.

The following gentleman was then proposed as a regular Member. A. P. Hallock, Ph.D.; proposed by T. O'C. Sloane, M. Benjamin, and Wm. Rupp.

The fourth paper of the evening, "*Upon the Direct Conversion of Aromatic Amides into their Corresponding Azo-compounds*," by A. R. Leeds, Ph.D., was then read. Dr. Leeds presented some additional results obtained by the treatment of aromatic substances with hydrogen peroxide. In a former communication, Dr. Leeds had stated that when palladium foil, saturated with hydrogen, was left in contact with pure water and purified air in a flask for several days, an amount of hydrogen peroxide was formed sufficient to be examined by various qualitative tests, and permitting of ready quantitative determination. The experiment was tried in order to discover by what reaction phenol is formed when, as originally pointed out by Prof. Hoppe-Seyler, hydrogenised palladium is left in contact with benzene and water. That it is really due to the substitution of hydrogen by hydroxyl, and not, as inferred by Hoppe-Seyler, to the action of oxygen rendered active by the oxidation of the hydrogen liberated in the nascent state from the palladium foil, was further shown by an experiment in which benzene was changed to phenol by boiling with hydrogen peroxide. In the latter experiment some oxalic acid and brown colouring matter were formed as well. Naphthalene was partly converted by similar treatment into naphthol, and anthracene was entirely changed to anthraquinone. Phenol and naphthol were little affected at ordinary temperatures, while on heating with hydrogen peroxide they were converted into tars. Nitrobenzene and benzenesulphonic acid were not changed. Diphenylamine, dimethylaniline, naphthylamine, xylidine, and orthotoluidine in glacial acetic acid solution, were changed mostly into tarry bodies, along with certain colouring matters. From these products, no crystallisable compounds could be separated by sublimation or by solvents. Paratoluidine, however, was converted into parazotoluene (M. P. 143° to 144°), crystallising in long long brilliant orange needles, and aniline into azobenzene.

After some questions by Mr. Stebbins, the fifth paper of the evening, "*On the Chemical Contents of the Fluid Cavities of Minerals*," by Mr. A. A. Julien, was then read.

Some remarks by Messsrs. Elliott and Doremus then followed. After which the Society adjourned.

CORRESPONDENCE.

THE SO-CALLED "BUNSEN"-PUMP.

To the Editor of the Chemical News.

Sir,—Permit me the space of a very few lines by way of rejoinder to Dr. Sprengel's remarks in your issue of the 3rd inst.

It would appear that the sore point with Dr. Sprengel is the use of the word "pump" in its connection as "Bunsen-pump" or "filter-pump." Had the apparatus been termed simply Bunsen's filter, or filter-apparatus, there would have been no offence to attach. Hence, I suppose, the reference to a variety of apparatus into certain connection with which the Sprengel-pump comes, and the query in effect—Why are not all these things called pumps? In any case all will allow that Dr. Sprengel is the inventor of the *water air-pump*, but not of the *Bunsen-filter*, which differs as a whole—according to Dr. Sprengel's own showing—from the pump itself as widely as a Bunsen's burner does from a spectroscope! Finally, to quote another paragraph in the letter in question, Dr. Sprengel says—"In our utilitarian age one is expected not only to build a ship on a new principle, but to sail her as well, and discover an America. This is hardly fair to the shipbuilder." To carry out Dr. Sprengel's metaphor, I cannot see for my part either that a shipbuilder is necessarily expected to navigate his own ship, newly invented or otherwise, or that the inventor of an apparatus is to be expected necessarily to apply his own invention in any or every direction; but, on the other hand, the "sailing the ship and discovering an America" by its aid involves just that combination of means to a great and beneficent end which has made famous the name of Columbus.—I am, &c.,

Verax.

BAROMETER PUMPS.

To the Editor of the Chemical News.

Sir,—I am much obliged by your having published my letter on this subject. You are quite right in stating that the barometer pump which I invented in 1847 is a different instrument from that invented by Dr. Sprengel about 1864. As long as he confined his claim to being the inventor of the instrument which he really did invent I had no right to interfere, but in your pages, and in another magazine, he has put forth the claim to being the owner of the *principle* of these instruments, and your correspondent "Verax" has credited Dr. Sprengel with the right to this claim, which I dispute. First, because no man can invent a *principle*; and, secondly, no man can obtain a patent for a *principle*. In my patent of 1847 I do not claim to be the inventor of the *principle* of the barometer pump, but I claim to be the first party who applied a barometer pump for any purpose whatever. The application I put the barometer pump to was for the emptying vacuum pans of sugar without destroying the vacuum. Dr. Sprengel subsequently followed my footsteps by applying a barometer pump for another purpose, and he has a right to be considered as the inventor of the instrument he planned, but his barometer pump and my barometer pump depend for their action on one and the same principle, and I am the first party who applied that principle in the form of a barometer pump, and I am the first inventor of a barometer pump and the father of barometer pumps. Hoping that you will find room for this.—I am, &c.,

James Johnstone.

Experiment Rooms, 1, James Square,
Edinburgh, June 4, 1881.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences. No. 18, May 2, 1881.

Inverse Electro-Motive Force of the Electric Arc.—J. Jamin.—The author shows that every continuously acting machine, every battery, or accumulator, like those of Planté or Faure, is less efficient as a source of electric light than magneto-electric machines with alternating currents like those of Gramme.

Examination of Certain Artificial Minerals Produced by James Hall.—F. Fouqué and M. Lévy.—The authors have been requested by M. Daubrée to examine certain artificial products in his possession, obtained at the end of the last century by James Hall. They conclude that Hall was the first who succeeded in reproducing artificially an eruptive crystalline rock.

Salicylic Acid and its Applications.—M. Schlumberger.—This acid in very small doses checks the action of the nitrogenous ferments, with which it forms stable compounds. It is also advantageously employed in the preservation of articles of food.

Principle of the Conservation of Electricity, or Second Principle of the Theory of Electric Phenomena.—G. Lippmann.—The sum of the quantities of free electricity is invariable, since its total variation is always equal to zero. This law the author calls the principle of the conservation of electricity.

Acetylic Derivatives of Cellulose.—M. Franchimont.—The author, on treating cellulose with acetic anhydride to which a little sulphuric acid has been added, obtains two new bodies.

Action of Sulphuric Acid upon Acetic Anhydride. M. Franchimont.—The author obtains acetyl-sulphuric acid, which passes into sulphacetic acid.

Reagent for Distinguishing the Ptomaines from the Vegetable Alkaloids.—P. Brouardel and E. Boutmy.—If a substance isolated by the method of Stas behaves with potassium iodo-mercurate as do the vegetable alkaloids, and if it has no action upon potassium ferricyanide, a vegetable alkaloid is present. If the ferricyanide is reduced to ferrocyanide, whilst the base is also precipitated by an iodo-mercurate, it is a ptomaine. In applying the test the base extracted from the body under examination is converted into a sulphate, and a few drops of the solution of this salt are placed in a watch-glass which already contains a little ferricyanide dissolved. A drop of neutral ferric chloride added to the mixture gives a precipitate of Prussian blue if the base isolated is a ptomaine.

A Compound of Iodoform and Strychnine.—M. Lextrait.—The compound in question results from the combination of 1 equiv. strychnine and 3 equivs. iodoform. An analogous compound is formed with quinine.

Journal für Praktische Chemie.

Parts 13 and 14, 1880.

Liquid Phosphorus Sulphide.—H. Schulze.—The author concludes that the liquid sulphides of phosphorus are not true chemical compounds. Sulphur and phosphorus in these combinations reach the limits of the physical divisibility. In processes of solution only one of two bodies loses its solid condition, the other being already liquid. Here both components pass from the liquid to the solid state by the mutual attraction of their molecules. Liquid phosphorus sulphide is no more a mechanical mixture than a chemical compound, and ranks with the great number of manifold arrangements of matter which owe their origin to molecular forces without being molecular compounds from the point of view of modern chemistry.

The Atomic Weight of Antimony.—R. Schneider.—A reply to H. Kessler's paper (*Berichte Chem. Gesell.*, 1879, p. 1044, and *Journal für Prakt. Chem.*, 21, 114). The author confirms the accuracy of his former determinations, and gives the atomic weight in question as 120·182.

Di- and Tri-Carbinols.—H. Kolbe.—As far as our present experience extends all the compounds known as aromatic contain a trimethin or tricarbin radicle, phenyl, or its derivatives. Acetic and benzoic acids are distinguished from each other, not thereby that the atoms in the former form an open and in the latter a closed ring, but that acetic acid possesses a mono-carbine methyl, whilst benzoic acid has a tricarbine phenyl in combination with carboxyl. We have at present no accurate definition of fatty and aromatic compounds, but may perhaps arrive at it if we distinguish three classes of organic compounds: 1, such as contain mono-carbines only; 2, those in which dicarbines are present, alone or along with mono-carbines; and 3, those which contain tricarbines. To the first class belong the fatty acids, their alcohols, aldehyds, and ketones; to the second the bibasic acids with their alcohols, &c., and the majority of the carbohydrates; and to the third class all those compounds which we name aromatic.

Results of the Norwegian Expedition to the Polar Seas.—L. Schmelk.—The results are given in a series of six tables.

A Contribution to the Knowledge of Coal.—Dr. H. Reinsch.—The author considers it probable that he has discovered chenopodine in coal.

Chemistry of Gall.—G. Hüfner.—The author calls attention to "Herodotus" (Book IV., Cap. 58), where it is asserted that cattle fed on the grass growing in Scythia have a larger supply of gall than others. He hopes that some chemist living in Southern Russia will examine the fresh ox gall of that country as to its behaviour with hydrochloric acid and ether.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin.

Vol. 13, No. 10.

Vapour-Density of Iodine.—V. Meyer.—In this paper the author discusses the criticism to which his works have been submitted by M. Crafts, and pronounces the objections to his earlier determinations of temperature well-founded. The objections to his determinations of vapour-density he thinks baseless, and announces that his former statement of the vapour-density of iodine at about $1050° = \frac{2}{3}I_2$ as confirmed by repeated experiments.

α-Nitroso-propionic Acid.—H. Gutknecht.—The author describes the properties of this acid, which, on reduction with tin and hydrochloric acid, yields alanine.

The Relations between the Physical Attributes of Bodies and their Chemical Constitution (Second Communication: See xii., p. 2135, and *Liebig's Annalen*, 200, 139).—J. W. Brühl.—The author states as the result of his researches that the atomic refraction of chlorine, bromine, and iodine, is unchangeable, the polyvalent elements only possessing a varying atomic refraction.

Chemisches Central-blatt.

Vol. 11. No. 37.

Spectroscopic Researches.—G. L. Ciamician.—Carbon has two spectra, one of the first and one of the second order, and this follows the general rule that each element has two spectra. Among the carbon compounds only cyanogen, carbon monoxide, and acetylene have peculiar spectra.—*Wiener Anzeiger*, 1880, 138.

Decomposition of Simple Organic Compounds by Zinc Powder.—H. Jahn.—Zinc powder acts upon the alcohols and analogous compounds, chiefly by removing hydrogen. Acids and certain of their derivatives yield corresponding ketones, carbonic acid and water being split off.—*Wiener Anzeiger.*

Action of Mercurethyl upon the Iodides of the Hydrocarbons.—W. Suida.—Mercurethyl and allyl-iodide mutually decompose each other at 120°.—*Wiener Anzeiger.*

On Ozone.—O. Liebreich.—We know nothing of an exact determination of ozone, and as if imbibed it is at once destroyed, its therapeutic action is inconceivable.—*Deutsch. Med. Wochenschrift.*

Bulletin de la Société d'Encouragement pour l'Industrie Nationale.

December, 1880.

This issue contains no chemical memoirs.

THE CHEMICAL NEWS.

Vol. XLIII. No. 1125.

ON THE
SPECTRUM OF MAGNESIUM UNDER VARIOUS CIRCUMSTANCES.*

By G. D. LIVEING, M.A., F.R.S., Professor of Chemistry, and J. DEWAR, M.A., F.R.S., Jacksonian Professor, University of Cambridge.

(Concluded from p. 214.)

The Magnesium-hydrogen Spectrum.

In the *Proc. Roy. Soc.*, vol. 27, p. 494, and vol. 30, p. 93, we have recorded a series of experiments which led us to attribute to magnesium together with hydrogen a peculiar spectrum. This spectrum we have on no occasion been able to detect in the absence of hydrogen. Observations on the spark discharge in nitrogen, in carbonic oxide, and in hydrogen, at reduced pressures, confirmed the results given in the first-mentioned paper, when the discharge was taken in the gases at atmospheric pressure. It was further shown that this peculiar spectrum could be reversed during the voltaic discharge in a lime crucible, provided magnesium and hydrogen were both present, but not in the absence of hydrogen. Likewise the flame of burning magnesium was found to emit this spectrum when the combustion occurred in an atmosphere containing either free or combined hydrogen. In summing up our results the following opinion was expressed:—

"The experiments above described, with nitrogen and carbonic oxide at reduced pressures, are almost if not quite conclusive against the supposition that the line at 5210 is due merely to the lower temperature of the spark in hydrogen. From De La Rue and Müller's observations it would appear that nitrogen at a pressure of 400 millims. should produce much the same effect on the spark as hydrogen at 760 millims. Now the pressures of the nitrogen and carbonic oxide were reduced far below this without any trace of the line in question being visible. Moreover, the magnesium line at 4481, which is not seen in the arc, and may be reasonably ascribed to the higher temperature of the spark, may be seen in the spark at the same time as the line at 5210 when hydrogen is present. Nevertheless, temperature does seem to affect the result in some degree, for when a large Leyden jar is uesd, and the gas is at the atmospheric pressure, the line almost disappears from the spark, to reappear when the pressure is reduced; but by no variation of temperature have we been able to see the line when hydrogen was carefully excluded.

"A line of the same wave-length has been seen by Young in the chromosphere once. Its absence from the Fraunhofer line leads to the inference that the temperature of the sun is too high (unless at special times and places) for it sproduction. If it be not due to a compound of magnesium with hydrogen, at any rate it occurs with special facility in the presence of hydrogen, and ought to occur in the sun if the temperature were not too high.

"We have been careful to ascribe this line and its attendant series to a mixture of magnesium and hydrogen rather than to a chemical compound, because this expresses the facts, and we have not yet obtained any independent evidence of the existence of any chemical compound of those elements."

This spectrum (of which a figure was exhibited) consists of two sets of flutings, closely resembling in character the hydrocarbon flutings, each fluting consisting of a multitude of fine lines closely set on the less refrangible side, and becoming wider apart and weaker towards the more refrangible side, but extending under favourable circumstances much further than is shown in the figure. The set in the green is the stronger, and it was to this that our former observations were confined. It has two flutings, one beginning at about wave-length 5210 and the other close to *b*, on its more refrangible side. The other set consists of three principal flutings, of which the first begins at about wave length 5618, the next at about wave-length 5566, and the third begins with three strong lines at about the wave-lengths 5513, 5512, 5511. Both sets are very well seen when a magnesium wire is burnt in the edge of a hydrogen flame, and in the arc in a crucible of magnesia when a gentle current of hydrogen is led into it.

As Mr. Lockyer, in a paper entitled "A New Method of Spectrum Observation" (*Proc. Roy. Soc.*, vol. 30, p. 22), has brought forward this spectrum as illustrative and confirmatory of his views regarding the possibility of elemental dissociation at different heat-levels, we have been induced to review our former work. The view taken by Mr. Lockyer may be expressed in his own words.

"The flame spectrum of magnesium perhaps presents us best with the beautiful effects produced by the passage from the lower to the higher heat-level, and shows the important bearing upon solar physics of the results obtained by this new method of work. In the flame the two least refrangible of the components of *b* are seen associated with a line less refrangible so as to form a triplet. A series of flutings and a line in the blue are also seen. On passing the spark all these but the two components of *b* are abolished. We get the wide triplet replaced by a narrow one, the two lines of *b* being common to both.

"May we consider the existence of these molecular states; if so, then the metals will exist in different molecular groupings, and we shall be able, by spectrum observations, to determine the particular heat level to which the molecular complexity of the solid metal, induced by chemical affinity, corresponds. Examples.—None of the lines of magnesium special to the flame spectrum are visible in the spectrum of the chloride either when a flame or a spark is employed."

In order to ascertain if this spectrum could be produced at a high temperature in the presence of hydrogen, which we have already shown to be essential to its production at the atmospheric and at reduced pressures, the series of experiments already mentioned in describing the spark spectrum were made with hydrogen at pressures increasing up to twenty atmospheres.

On the supposition that this spectrum originates from the formation of some chemical compound, probably formed within certain limits of temperature when vapour of magnesium is in presence of hydrogen, the stability of the body ought to depend largely on the pressure of the gaseous medium. Like Graham's hydrogenium, this body might be formed at a temperature at which it would be usually decomposed, provided the pressure of the hydrogen were correspondingly increased. In fact, it has been shown by Troost that the hydrides of palladium, sodium, and potassium all follow strictly the laws of chemical dissociation enunciated by Deville; and increased pressure by rendering the compound more stable, provided the secondary effect of such pressure in causing a higher temperature in the electric discharge were not overpowering, ought to conduce to a more continuous and brilliant spectrum of the compound. Conversely, if such a more continuous and brilliant spectrum be found to result, in spite of the higher temperature, from increased pressure, it can only be explained by the stability of the substance being increased with the pressure.

Now what are the facts? When the spark of an induction-coil, without a Leyden jar, is passed between magnesium electrodes in hydrogen at atmospheric pressure, the flutings in the green are, as before described, always seen, but they are much stronger at the poles and do not

---

* A Paper read before the Royal Society, May 12, 1881.

always extend quite across the field. As the pressure is increased, however, they increase in brilliance and soon extend persistently from pole to pole, and go on increasing in intensity, until at fifteen and twenty atmospheres, they are equal in brilliance to the *b* group, notwithstanding the increased brightness these have acquired by the higher temperature, due to the increased pressure. The second set of flutings, those in the yellowish green, come out as the pressure is increased, and, in fact, at twenty atmospheres only the *b* group and the fluting are noticeable; if the yellow magnesium line be visible at all it is quite lost in the brilliance of the yellow flutings. The tail of fine lines of these flutings extend at the high pressure quite up to the green, and those of the green flutings quite up to the blue. On again letting down the pressure the like phenomena occur in the reverse order, but the brilliance of the flutings does not diminish so rapidly as it had increased. If, now, when the pressure has again reached that of the atmosphere, a large Leyden jar be interposed in the circuit, on passing the spark the flutings are still seen quite bright, and they continue to be seen with gradually diminishing intensity until the sparks have been continued for a considerable time. It appears that the compound, which had been formed in large quantity by the spark without jar at the higher pressures, is only gradually decomposed, and not re-formed, by the high temperature of the spark with jar. This experiment, which was several times repeated, is conclusive against the supposition that the flutings are merely due to a lower temperature. When the pressure was increased at the same time that the jar was employed, the flutings did not immediately disappear, but the expansion of the magnesium lines and the increase of the continuous spectrum seemed to overpower them.

When nitrogen was substituted for hydrogen, the strongest lines of the green flutings were seen when the spark without jar was first passed at atmospheric pressure, probably from hydrogen occluded, as it usually is, in the magnesium electrodes. As the pressure was increased they speedily disappeared entirely and were not again seen either at high or low pressures.

With carbonic oxide the same thing occurred as with nitrogen; but in this gas the flutings due to the oxide of magnesium (wave-length 4930 to 5000) were, for a time, very well seen.

Ciamician ("*Sitzungsber. Akad. Wissensch.*," Wein, 1880, p. 437) has described a spectrum of magnesium of the first order ("Plücker's Nomenclature") obtained by taking sparks from an induction coil, without a jar, between magnesium electrodes in an atmosphere of hydrogen. He gives a figure to a scale of this spectrum, but it is not to a scale of wave-lengths, so that exact comparison of his observations with ours is difficult. The least refrangible set of flutings in his figure corresponds very well with that we have described in the yellowish green. The next set, in the green, in his figure does not, however, correspond exactly with ours; it begins nearer to *b* than we have observed, and consists of four flutings, whereas we observed but two in this set. It looks as if, in his figure, the magnesium-hydrogen spectrum were superposed upon the hydrocarbon spectrum in this region. Further, he gives a third more refrangible set of flutings which we have not observed at all in the magnesium-hydrogen spectrum. This third set of flutings, as drawn in his figure, appears to be somewhat more refrangible than the set due to the oxide, and occupies nearly the place [illegible] the blue hydrocarbon series, but a passage in the text, in which he says that the magnesium spectrum of the second order might, without measurement, easily be taken to be identical with that of carbon, almost negatives the supposition that this set of flutings is the blue hydrocarbon set and mistaken for a magnesium spectrum of the first order. To whatever it may be due, we have not seen anything like it under the circumstances described by him, though our observations on the spark spectrum of magnesium in hydrogen have now been repeated with all the variations of circumstance which we could devise.

Mr. Lockyer states (*loc. cit.*) that none of the lines of magnesium, special to the flame spectrum, are visible in the spectrum of the chloride, either when flame or spark is employed. But we find that when the spark is taken between platinum points, from a solution of the chloride of magnesium, in a tube such as those used by Delachanal and Mermet, the line at wave-length 5210 can frequently be seen in it when the tube is filled with air, and that if the tube be filled with hydrogen the green flutings of magnesium-hydrogen are persistent and strong,

Repeated observations have confirmed our previous statements as to the facility with which the magnesium-hydrogen spectrum can be produced in the arc by the help of a current of the gas. In a magnesia crucible, by regulating the current of hydrogen, the flutings can be easily obtained either bright or reversed.

Comparison of the Spectra.

When we compare the spectra of magnesium in the flame, arc, and spark, we observe that the most persistent line is that at wave-length 2850, which is also the strongest in the flame and arc, and one of the strongest in the spark. The intensity of the radiation of magnesium at this wave-length is witnessed by the fact that this line is always reversed in the flame as well as in the arc when metallic magnesium is introduced into it, and in the spark between magnesium electrodes when a Leyden jar is used. It is equally remarkable for its power of expansion. In the flame it is a broad band, and equally so in the arc when magnesium is freshly introduced, but fines down to a narrow line as the metal evaporates.

Almost equal in persistence are the series of triplets. Only the least refrangible pair of these triplets are seen in the flame, another pair are seen in the spark, but the complete series is only seen in the arc. We regard the triplets as a series of harmonics, and to account for the whole series being seen only in the arc we must look to some other cause than the temperature. This will probably be found in the greater mass of the incandescent matter contained in the crucible in which the arc was observed.

The blue line of the flame at wave-length 4570 is well seen in the arc, and is easily reversed, but is always a sharp line, increased in brightness but not sensibly expanded by putting magnesium into the crucible. In the spark, at atmospheric pressure, it is only seen close to the pole or crossing the field in occasional flashes; but seems to come out more decidedly at rather higher pressures, at least in hydrogen.

The series of bands near L, well developed in the flame, but not seen at all in the arc or spark, look very much like the spectrum of a compound, but we have not been able to trace them to any particular combination. Sparks in air, nitrogen, and hydrogen have alike failed to produce them.

The very strong, rather diffuse triplet at M, with which they end so closely, resembles in general character the other magnesium triplets, that it may well be connected with that constitution of the magnesium particle which gives rise to the triple sets of vibrations in other cases, but, if so, its presence in the flame alone is not easily explained.

The occurrence of this triplet in the ultra-violet, and of the remarkable series of bands associated with it, as well as the extraordinary intensity of the still more refrangible line at wave-length 2850, which is strongly reversed in the spectrum of the flame, corroborates what the discovery of the ultra-violet spectrum of water had revealed, that substances at the temperatures of flames while giving in the less refrangible part of the spectrum more or less continuous radiation, may still give, in the regions of shorter wave-length, highly discontinuous spectra, such as have formerly been deemed characteristic of the highest temperatures. This subject we will not discuss further at present, but simply remark what we have stated formerly, that "it opens up questions as to the enormous power for radiation of short wave-length of gaseous bodies at the comparatively low temperature of flame with regard to which we are accumulating facts."

In the arc and spark, but not in the flame, we have next a very striking group of two very strong lines at wave-lengths about 2801 and 2794, and a quintuple group of strong but sharp lines above them. The former are usually reversed in the spark with jar, and all are reversed in the arc when much magnesium is present. There are also several single lines in the visible part of the spectrum common to the arc and spark. All of these may be lines developed by the high temperature of the arc and spark. Two blue lines in the arc have not been traced in the spark, but their non-appearance may be due to the same cause as that above suggested for the non-appearance of the higher triplets, the smallness of the incandescent mass in the spark.

A pair of lines in the arc near U appear to be represented in the spark by an equally strong, or stronger, pair near but not identical in position. The possibility of such a shift, affecting these two lines only in the whole spectrum and affecting them unequally, must in the present state of our knowledge be very much a matter of speculation. Perhaps sufficient attention has not hitherto been directed to the probability of vibrations being set up directly by the electric discharge independently of the secondary action of elevation of temperature. Some of the observations above described, and many others well known, indicate a selective action by which an electric discharge lights up certain kinds of matter in its path to the exclusion of others; and it is possible that in the case of vibrations which are not those most easily assumed by the particles of magnesium, the character of the impulse may slightly affect the period of vibration. The fact that, so far as observations go, the shift in the case of this pair of magnesium lines is definite and constant, militates against the supposition suggested. On the other hand, the ghost-like pairs of lines, observed in the spark below the triple near L, suggest the idea that some of the particles have their tones flattened by some such cause.

The strong pair at wave-length 2801, 2794, are accompanied in the spark, but not in the arc, by a much feebler, slightly more refrangible pair, but these have not the diffused ghost-like character of those just alluded to.

These lines are phenomena of the high potential discharge in which particles are torn off the electrodes with great violence, and may well be thrown into a state of vibration which they will not assume by mere elevation of temperature.

There are two lines in the spark besides the well-known line at wave-length 4481 which have not been observed in the arc, but they are feeble and would be insignificant if it were not the fact that they, as well as wave-length 4481, are short lines seen generally only about the poles, appear to be present in the solar spectrum. In the sun we seem to have all the lines common to the flame, arc, and spark (unless the line given in Ångström's map at 4570·9 be not identical as we believe it to be with the magnesium line), and possibly, judging by Draper's photograph, the strong triplet of the flame at M; but one line common to the arc and spark at wave-length 4703 does not appear in the sun, at least in Ångström's map. It is hard to account for its absence, since it is a bright and conspicuous line in the arc, and usually seen, though less prominent, in the spark. We have noticed, however, that when the spark is taken in hydrogen, the line at wave-length 4570 appears stronger than that at wave-length 4703, while the reverse is the case when the atmosphere is nitrogen. It is possible then that the atmosphere may, besides the resistance it offers to the discharge, in some degree affect the vibrations of the metallic particles.

When we have made all the simplifications that we can by eliminating, as we hope we have done satisfactorily, the hydrogen-magnesium flutings, and by supposing the whole series of triplets to be harmonically related, and possibly some of the single lines also to be similarly related, we have still the fact that the chemical atoms of magnesium are either themselves capable of taking up a great variety of vibrations, or are capable by mutual action on each other, or on particles of matter of other kind, of giving rise to a great variety of vibrations of the luminiferous ether; and to trace satisfactorily the precise connexion between the occurrence of the various vibrations and the circumstances under which they occur, will require yet an extended series of observations.

ON THE DETERMINATION OF POTASSIUM AS POTASSIUM PLATINO-CHLORIDE.

By ROBERT R. TATLOCK, F.R.S.E., F.I.C., F.C.S.

On May 1, 1880,—that is, more than a year ago—I sent a circular on the above subject to all the manufacturers of potash salts in Germany, so far as I could discover them. This is the "circular" referred to by Drs. Zuckschwerdt and West in their communication on the above subject, which appeared in the Chemical News, vol. xliii., p. 251. For reasons, however, which will presently appear, these gentlemen have not produced the circular, but have merely quoted from it a portion to suit their own purposes, and which is the least essential.

The following is a fair copy of the circular, which, it will be seen, is a challenge to the German manufacturers. Up to the present moment that challenge, for obvious reasons, remains unaccepted:—

City Analysts' Laboratory,
138, Bath Street, Glasgow.
1st May, 1880,

"To the Manufacturers of Potash Salts in Germany.

"Gentlemen,—You are aware that for many years past I have had occasion to analyse samples of Muriate of Potash and other Potash Salts, representing shipments to consumers and merchants in this country, and that in very many instances dissatisfaction has been expressed on account of differences between my analyses and those of German chemists, and which, it is represented, arise from a slight modification of the platinum process for the estimation of Potassium which I have found it necessary to adopt, when Sodium Salts are present, in order to get accurate results. I have endeavoured on all occasions to satisfy manufacturers and others who objected to my method of analysis, that it did not give results lower than the truth, and I have frequently furnished them with a written description of it, in order that they might examine it for themselves, but, I regret to say, without success; and as I am no longer able to continue detailed correspondence on the subject, I beg hereby to make them the following offer, jointly and separately, with the object of having that point settled once for all:—

"That Professor Fresenius, of Wiesbaden, be requested to make three test experiments on my process, using *Pure* Chloride of Potassium, and that he grant a certificate stating the results separately, and also the mean.

"That in the event of the mean result coming out lower than the truth, I shall agree to add the difference in all future analyses made by me.

"That the experiments be made by Professor Fresenius, or his assistant, in his laboratory at Wiesbaden, in my presence and in that of a representative chosen by the German manufacturers, but neither of us to have anything to do with the manipulation.

"That Professor Fresenius supply all the materials and apparatus, and that he be the sole arbiter on all points that cannot be tested by experiment.

"That under any circumstances I charge nothing for my time: but that, in the event of the mean result coming out above 99·5 per cent, the manufacturers will pay my travelling and hotel expenses from and back to Glasgow; and that, whatever the result may be, the manufacturers will pay Fresenius's fees.

"The following is my process herein referred to:—Dissolve 35 grms. of the sample in water, filter if necessary, and make up the bulk to 500 c.c. Deliver 10 c.c. of the solution into a small porcelain basin, add 20 c.c. of water, stir, then add 30 c.c. of a solution of platinic chloride containing 7 grms. of metallic platinum in every 100 c.c. Evaporate on water-bath, but not to perfect dryness, add a few drops of water and evaporate again, remove the basin and stir the ppt. well with 2 c.c. of the platinum solution, then wash the ppt. on the filter with 1 c.c. more. Now wash the basin and filter and contents with the smallest possible quantity of alcohol of 95 per cent. Dry filter containing the precipitate, on the water-bath, remove the precipitate, as completely as possible, into a small platinum capsule, dry at 100° C. and weigh. Ignite the filter with trace of adhering precipitate, weigh the residue of $Pt+2(KCl)$ which is left, calculate its weight to $2(KCl)PtCl_4$ and add the weight to that of the precipitate already obtained.

"I enclose an extra copy of this letter, and will thank you to make my offer as widely known as possible.

"I am, Gentlemen,
"Your obedient Servant,
"(*Signed*) Robert R. Tatlock."

In place of accepting this challenge—which every unbiassed person will admit is fairness itself—our German friends have followed the ingenious, but to us rather unsatisfactory, plan of getting their own chemists to make experiments privately upon my method, and to tell us what results they got in this way, when nobody was present to verify them, and affect to be simple enough to suppose that we shall credit these results in the face of so much evidence to the contrary, obtained by eminent chemists, both of their own country and this.

It would be be a very easy matter for me to come forward, as our two doctors have done, with some figures written on a sheet of paper, and state that these were results which I had obtained privately, and that they entirely confuted theirs; but as I am, like them, an interested party in this discussion, I quote no results of my own, but only those of chemists of repute, who have no interest one way or another.

The experiments made by the two doctors go to show that my method, in their hands, gives on an average result 0·35 per cent of chloride of potassium too low. Let us see what Fresenius's practice and opinion are as regards this. Some time ago a portion of a carefully mixed and pounded sample of muriate of potash—of which I had made previously a complete analysis—was forwarded by a well-known firm to Fresenius, unknown to me, with the request that he would spare no pains to arrive at the truth regarding the relative proportion of potassium and sodium salts which it contained. The following are the results of the respective analyses:—

	Tatlock. Per cent.	Fresenius. Per cent.
Chloride of potassium	88·50	88·86
Sulphate of potash	0·13	—
Chloride of sodium	8·46	8·39
Sulphate of lime..	0·18	0 22
Chloride of magnesium	0·50	0·47
Insoluble	0·23	0·23
Water	1·80	1·83
	99·80	100·00
Potash	55·97	56·10
Equal to chloride of potassium	88·60	88·86

With reference to these results and my method, Fresenius wrote at the same time as follows:—"He makes the chloride of potassium 0·21 per cent lower than I. The discrepancy, however, will scarcely ever be greater." Here, then, is a guarantee from Fresenius himself, not only that my analysis, but that my method, was correct within 0·21 per cent; and a difference such as this is not considered of much importance among German chemists who are authorities on potash analysis, for Dr. G. L. Ulex, of Hamburg, in giving an account of his process, states that he obtains results reliable within 0·2 per cent, and adds with regard to his method—"That although simple, it requires to be worked carefully, otherwise serious mistakes may be made."

It would appear, further, that Fresenius, notwithstanding his *own results* and *opinion*, has given the two doctors a certificate to the effect that their experiments were carefully conducted, although he did not see them made, but merely *read the essay* in which their results were stated.

In addition to this we have the experiments made by the Committee of the British Association for the Advancement of Science, appointed to report "On the Methods Employed in the Estimation of Potash." I did not suggest the formation of that Committee, was not a member of it, and had nothing to do with its work. It consisted of Prof. Dewar, of the Royal Institution, London; Mr. A. H. Allen, Public Analyst, Sheffield; and Mr. E. C. C. Stanford, who is a manufacturer of potash salts.

The following are the experiments referred to, and were made by the Committee upon mixtures of pure potassium and sodium chlorides by my process:—

Comparison of the Actual Composition of Mixtures of Potassium and Sodium Chlorides with the results obtained.

Large Excess of Platinum.

KCl taken. Per cent.	NaCl taken. Per cent.	KCl obtained. Per cent.	Error.
82	18	82·09	+0·09
82	18	82·15	+0·15
82	18	82·12	+0·12
82	18	82·20	+0·20
50	50	49·67	−0·33
50	50	49·60	−0·40
50	50	49·80	−0·20
50	50	49·72	−0·28
50	50	49·87	−0·14
50	50	49·91	−0·09
50	50	49·98	−0·02
67	33	66·63	−0·37
67	33	66·77	−0·23
		Average	−0·11

It will thus be seen that the average error of thirteen experiments is 0·11 per cent, a result which I think all will admit is sufficiently near the truth, and these trials were made with a large excess of chloride of platinum.

The buyers and consumers of German muriate of potash here will now have no difficulty in perceiving how matters stand, and will think twice before they will accept German analyses showing 100 per cent between chloride of potassium and water *alone* in an article like commercial muriate of potash, which is sure to contain, in addition, chloride of sodium, sulphate of lime, chloride of magnesium, and insoluble matter, for which, however, many German analyses leave no room.

I have only further to remark that Dr. Zuchschwerdt and West's experiments, undertaken with the object of showing the non-interference of sodium salts by their process, where *none were present*, has clearly no bearing on the question.

Action of Light upon Silver Bromide.—G. Noel.—Silver bromide preserves the molecular modification impressed upon it by the chemical spectrum, so much the longer as its sensibility is greater.—*Comptes Rendus.*

ON THE

VENTILATION OF HALLS OF AUDIENCE.*

By ROBERT BRIGGS,
Member of the American Society of Civil Engineers.

(Continued from p. 254.)

Returning from the long digression of comparison of American with foreign requirements, to the consideration of absolute requirements and practical demands. The following has been established by the previous argument, that for the support of life, each person must have one-third to one-half a cubic foot of fresh air each minute. That for the conservation of temperature to the point of comfort, each person supplied with air at 70 degrees in its usual condition of summer air in America, must have four to four and a half cubic feet per minute. That to maintain the freshness of air in a continuously occupied room, so that it shall be pure to the sense of smell—a condition which is found to correspond generally to the presence of 8 parts of carbonic acid to each 10,000 parts of air—about thirty cubic feet of air per person per minute is requisite. It has been shown also how audience halls, without systematic ventilation, or at best supplied with very limited quantities of air, are, if of adequate cubic content in comparison to the number of persons present, and if occupied only in short sessions, and if judiciously supplied with fresh air between the sessions, relatively healthy, comfortable, and acceptable to the persons attending them. The point for enquiry which now follows is—what is the practical limit for quantity of air to be *systematically supplied?*

The proposition before established, that the cubic contents of the hall can be reckoned as part of the supply itself, by taking the number of minutes the hall is occupied by a certain number of persons, becomes now of importance in fixing the limit for momentary supply, when the average length of session can be assumed. But this is really of less importance than would appear from mere statement. On the whole, in audience halls, the cubic capacity per sitter will be found to be from 200 to 300 cubic feet, or only 6 to 10 minutes supply of air to each person, where the final relative purity is to correspond to a supposed regular supply of 30 cubic feet per minute. If this cubic capacity is to be taken in addition to any regular supply for a given length of time, then if 100 minutes (1 hour 40 minutes) are taken as the length of the session, two to three cubic feet of air per minute becomes available as an addition to whatever is supplied.

The practical difficulties in ventilation of halls which effect the quantity of air to be supplied are those of introduction and of distribution. The difficulty of introduction is perhaps the most serious trouble. Dr. Reid's proposition for a perforated flooring would seem to present a satisfactory solution, and it is questionable if justice has been done the reputation of the scheme by the public, for the method continues in operation to this day, with twenty-four years' service at the Houses of Parliament; although embarrassed in its action by singularly unmechanical and inefficient apparatus for warming and supplying the air. It cannot be claimed, however, that the construction of a sub-hall for equalisation of pressure will meet the approval of architects or builders in future, and Dr. Reid's effort will probably remain as an example rather than be accepted as a model. But Dr. Reid was for a whole lifetime of arduous labour an intelligent and careful observer of the requirements for the ventilation of audience halls. As the result of his study he concluded, and he expressly states his conclusion as with diffidence, that 10 cubic feet of air to each individual would suffice to properly ventilate a hall. His great effort was to arrange to supply this quantity in such way as should be at once effective and imperceptible to an audience. Much of his want of success laid in the imperfections of his mechanisms, in the coils or heating surfaces, and in the fans or means of impelling air. Some of it laid in the effort to regulate the audience as well as the ventilation. His lifelong difficulty was found in the establishment of local currents engendered by his imperfect apparatus, and from the sensation of cold which such currents produce.

Systematic supply involves arrangements of ducts and passages by which the outer air, from some chosen point, shall be transported to certain desirable mouths of delivery or inlet registers. The dimensions to be given these ducts or passages are absolute and positive ones, when the quantity of air to be moved shall have been established by the number of persons and their supply, and when the velocity of movement of air is determined or accepted. The velocity of movement is limited on the one hand by the motive power applied to impel or effect it; that is, by the expenditure of force demanded; which means in the end, whether impulse by fans and engines, or a draft from a heated flue be used, expenditure of fuel, and, on the other hand, by practical dimensions accepted in construction of the ducts or passages.

In figures, ducts for forced ventilation must suppose currents of from 600 to 1200 feet per minute, with some allowance of sectional area for branch ducts, which shall admit a less velocity of flow through them; while ducts for currents induced by exhaust shafts, or produced by the entry of heated air, at the usual temperature of steam heated currents, will have a usual velocity of from 150 to 300 feet per minute—sometimes under favourable conditions for making a draft, rising to 300 or even to 600 feet per minute.

Systematic supply involves also the heating of air to be supplied, in an extreme case, from 5 degrees to 10 degrees below zero up to perhaps 75 degrees, in such extreme case of cold weather. Ventilation is not attained except at cost for fuel, and a reasonable expenditure in this regard will meet approval when restricting the amount of ventilation to the necessities for health. The heat *will* in all cases be that of comfort or the *system* will be discarded.

Finally, the writer has sought with diligence and study to determine from irrefragable data the exact quantity of fresh air that should be supplied to each person of an audience per minute, and he now finds himself compelled to admit that no such data exists. That the quantity must be taken to have an arbitrary value founded on economic and structural, as well as upon medical and chemical, considerations; that this value must have its authority from its general acceptation by the community or by its general acceptance by investigators, who will have considered the question from all points.

It would seem that for audience halls occupied for sessions not exceeding two or three hours' duration, Dr. Reid's value of 10 cubic feet of air per minute is all that should be arranged for when planning such halls—all that can be judiciously urged in the accomplishment of ventilation in view of the cost in fuel and apparatus, quite sufficient to meet the physiological issue, and so large that it ought to be accepted from the medical point of view. This quantity might be referred to the maximum seating or holding capacity of the room to which it should be applied, when its partial occupancy would go towards increasing the general supply. And it should be referred to the coldest weather heating-power of the accompanying heating apparatus, so that in case of emergency of lengthened sessions in milder weather and in hot weather the quantity could be materially exceeded. When a forced ventilation by means of a fan is adopted, the flues and passages should refer to a winter ventilation at half speed of the summer one, and the quantity of summer ventilation would then become 20 cubic feet per person per minute; an amount of ventilation which, with open doors and windows, would, if the ventilating currents are suitably distributed amongst the audience, prove ample to give all the comfort possible to a crowd gathered in hot weather.

For audience halls in legislative buildings there is a propriety in adhering to the larger quantity of air which

---

* A Paper presented to the American Society of Civil Engineers, January 26, 1881.

has been mentioned as needful to preserve the sensation of pure air to the smell in continuously occupied rooms—to wit, 30 cubic feet of air per person per minute. As before, this quantity should be referred to the maximum attendance in any hall, and the capacity of the heating apparatus be referred to the coldest weather for such quantity, so that the forced ventilation should be adequate to give a double supply in mid-summer.

In the mind of the writer there can be no question whatever as to the direction of ventilation in a hall. A man lives in an ascending current of air—he is enclosed in one. In a crowd, without ventilation, a circulation takes place: in some way the roll of air which rises above one's head is replaced by cooler air sucked in sideways at the feet, or downwards, between the persons who form the crowd. If fresh air can be, and is, introduced imperceptibly at the floor near the person who needs it, the rising current supplies, nearly unmixed by diffusion, the air for respiration, while the vitiated air is swept upwards with the advantage of its levity as well as of the current of supply. A downward system of ventilation, on the other hand, where the air is supposed to be abstracted at the floor, near to the individual, supposes a thorough admixture, mechanically, of the respired and vitiated air with the descending sheet of fresh air. Within any hall where the air enters at the top there could scarcely exist any fresh air whatever, while the degree of vitiation would increase downwards, until the occupants of the hall would breathe and live in the vilest air possible for any given supply of fresh air.

There is also another matter to be thought of in ventilation of halls—the ventilation of the gas-lights, and besides this ventilation, the removal of the heat they generate. The ordinary gas-burner consumes 4½ cubic feet of gas per hour. Each burner may be taken to demand 2700 cubic feet of gas per hour, or 45 cubic feet of air per minute, when the temperature of the gases of combustion, including the 45 cubic feet of air, becomes, for open burners, as high as 99 degrees, and for Argand burners possibly as high as 128 degrees. In an upward ventilation the gas-lights present little difficulty, as the air for ventilation of the persons composing an audience will commonly exceed in quantity the greatest requirements for gas-burning. The vitiations arising from gas-lights are very objectionable when the attempt to introduce air strictly at the ceiling is made. The figures given here as to the requirements of gas-lights will allow provision to be made for them in arranging the ventilation of halls. The radiation of heat from gas-lights of a brilliantly lighted room becomes not only an important addition to the heat of the air, but also to the heat of the occupants of the room, independent of its temperature in some degree. This effect of gas-light is sufficient to reduce the desirable average temperature of a gas-lighted room some two to five degrees, and the necessary temperature of admitted air should fall off in like degree. No amount of ventilation will make it comfortable to sit near the great chandelier.

It is a source of great satisfaction to know that the electric light has reached that point of development where it has become available for lighting audience halls. The practicability of electric lighting at present is found in the production of large quantities of light. As the introduction of gas-light led to the use of much greater illuminating power than was obtainable by candle lighting, however numerous, and sparkling the candle-lights may have been displayed from reflecting scones or chandeliers hung with lustres in old times, so the electric light also overpowers the gas light wherever substituted to much the same extent. The electric light is the nearest possible to the natural one of the sun. Properly arranged, to avoid distinct shadows, the correspondence to a carefully shaded room with ample midday light can be secured. Lighted from above, a complete avoidance of objectionable glare can be effected. Colours will have natural tints and values, and the gratification of our most delicate sense is not the least of promise in the perfection of electric lighting.

The vitiation of air by the electric light, arising from the slow combustion of the carbon, is too insignificant to form any element in considering the ventilation. For an equal quantity of light, there is generally seven hundred times as much carbonic acid in coal-gas lighting as in electric lighting. There is a small amount of vitiation from the electric light in the form of nitric or nitrous vapours, which may or may not accompany coal-gas burning to equal extent where equality of light-giving effect is made the standard of comparison. But this quantity of vitiation is also utterly harmless in the volume of air demanded for ventilation of the number of persons who are to derive their light from any given electric source. The heat effect of electric lighting is as favourable to the ventilation and comfort of audience halls as any other advantage presented. Thus, the same light-producing capacity gives thirty-four times as much heat for gas lighting as for electric lighting with equivalent light values, as the most unfavourable showing of the electric system, supposing all the force expended in the electric arc is transformed into heat. Furthermore, the superior safety of the electric light, as regards danger from fire, is not the least of its recommendations when enumerating advantages. At the present time the cost of electric lighting, with liberal allowance for use and deterioration of apparatus, is about one-half that of gas lighting, when the same quantity of light is supplied; but in view of the superior lighting usually practised when the electric system is introduced, the two methods approximate to the same cost generally.

Resuming the discussion of ventilation again. It must not be accepted from the foregoing remarks on downward ventilation that the removal of air at the floor of a hall is wholly impracticable. In rooms of limited floor area, like school rooms, an arrangement for supply and removal of air in conformity with the great natural circulation which occurs in all heated rooms, is likely to prove successful in those conditions of the weather which demand warm rooms. And as has been shown in our climate, there is but about one month in any year in which closed windows are desirable, *without an attendant supply of heat to the room*, it follows that such school rooms may be effectively ventilated during the eight months when our temperatures vary from zero to 40 or 50 degrees, that is for seven-eighths of the time when windows are closed. By judicious manipulation of windows and of eduction flues and their registers, the ventilation during the one month of closed windows without fire may be ameliorated, if not made altogether efficient.

Again, in churches and lecture rooms, where the economy of apparatus and of operating is esteemed superior to ample but expensive ventilation, the systematic provision and removal of much smaller quantities of air than have here been shown needful for desirable purity may accomplish much improvement in the direction of relative purity. The habitual method of warming a church building in America is by means of several hot-air furnaces, placed in the cellars underneath, as sources of heat, these furnaces having usurped the functions of the close stoves, with long lines of smoke-pipes, which were formerly a peculiar feature of the "meeting-houses" of our fathers. The furnaces have just about the same heating capacity, and the distribution and circulation of the heating currents within the walls of the church is effected in much the same way. When actively employed in warming the church by means of furnaces there is a supply of fresh heated air, considerable perhaps in itself, but inconsiderable, at its largest quantity, to the wants of ventilation of the numbers present. The control of temperature of the heating currents is very limited, the lowest temperature being commonly about 180 degrees, while the highest, often demanded in the coldest weather, rises to quite 300 degrees, and sometimes above this point; and the control of warmth in the church itself is obtained by closing or opening—registering off—the hot air current. In ordinary cases the registers are shut soon after the commencement of any session, and if the room be well filled, the heat of the persons present (especially at evening meetings, where gas-lights increase this heat) causes it to become over-heated long before the end of the hour, or hour and a half, of usual session.

The equilibrium of temperature in such a room is established solely by the cooling effects of the walls or windows, downwards along which there falls a sheet of cooled air (augmented in cold at the windows by leakages inwards at the bottom of the same), a sheet which flows inwards towards the register openings, and is directed upwards with the flow from them; or when the register is closed off, the sheet forms part of the current of personal origin rising in the middle of the room. This roll of circulation goes on continually, and at some degree of elevation of temperature at the top of the room, the lower strata reaching to the height of above a gallery sometimes will be found to have attained some uniformity of heat. In fact, when filled with heat, as the furnace constructors denominate it, there will, in a church building of 35 to 45 feet in height, be less than 10 degrees difference between the floor level temperature of air and that taken 20 to 25 feet above such level. No large ventilating shaft can be taken from the upper part of such a room. Even the small opening to remove the gases of combustion of a chandelier disturbs the circulation of heat and intensifies the cold descending currents near the window, besides accelerating the leaks of cold air at the cracks; so that the ventilation of churches thus heated is practically limited to what leaks *out* of heated air, at or near the tops of windows, and what leaks *in* of cold air at or near the bottom of the same. A systematic leakage, which on windy days is modified by all leaks *in* at the windward windows, and all leaks *out* at the leeward ones. Now a kind of semi-ventilation of a church thus warmed and arranged can be effected by removal of air, at or near the floor, by means of ducts connected to an exhaust shaft; all of which will become operative if the currents from the hot air registers have been augmented to meet the requirement of air, by tempering the heated currents with direct currents of cold air, to desirable heat and quantity. Here it is seen that a downward ventilation, under conditions, may effect a good purpose to a certain extent.

It will not be attempted at this time to argue fully the advantages of the method of supplying air for ventilation by impulse by mechanical means—the superiority of forced ventilation, as it is called. This mooted question will be found to have been discussed, argued, and combatted on all sides, in numerous publications; but the conclusion of all is, that if air is wanted, in any particular place at any particular time, it must be put there, not allowed to go. Other methods will give results at certain times or seasons, or under certain conditions. One method will work perfectly, with certain differences of internal and external temperatures, while another method succeeds only when other differences exist. One method reaches to relative success whenever a wind can render a cowl efficient. Another method remains perfect as a system if no malicious person open a door or window. No other method than that of impelling air by direct means, with a fan, is equally independent of accidental natural conditions, equally efficient for a desired result, or equally controllable to suit the demands of those who are ventilated; which last requirement, it will be shown further on, is more essential than to meet their necessities.

(To be continued.)

Certain Substitution-Derivatives of Azo-benzol.—A. Calm and K. Heumann.—The authors examine the behaviour of para-dichlor-hydrazo-benzol with hydrochloric acid, the results of the reaction being para-dichlor-azo-benzol and para-chlor-aniline. Para-dibrom-hydrazo-benzol is decomposed in an analogous manner. On prolonged treatment with weak fuming sulphuric acid at 140° to 150° para-dichlor-azo-benzol is converted into mono-sulpho-para-dichlor-azo-benzolic acid. There is also a description of the nitro-derivatives of para-dichlor-azo- and azoxy-benzol.—*Berichte der Deutschen.*

PROCEEDINGS OF SOCIETIES.

PHYSICAL SOCIETY.

Saturday, June 11th, 1881.

LORD RAYLEIGH in the Chair.

NEW members—Mr. J. E. H. Gordon and Mr. J. E. Stead, E.I.C.

Prof. FLEMING exhibited a new form of B.A. unit resistance coil, devised by him for experiments in the Cavendish laboratory, with a view to obviate the leakage in the older form due to condensed moisture on the paraffin insulating the electrodes, and also to facilitate the equalisation of the temperature of the coil with the medium it is placed in. For this purpose the wire is wound bare, each layer being insulated from the rest by ebonite fenders niched to receive the turns, and the coil is enclosed in a brass box, screwed together. This box is water-tight and may be soldered, or provided with an india-rubber washer between the two flanged halves which screw together.

Dr. STONE said he usually insulated the B.A. coil when plunging it in water, by putting it in a beaker of paraffin oil, which was immersed in turn in the water.

Prof. AYRTON pointed out the advisability of makers aiming rather at turning out exact resistances of any definite value than wasting time and increasing the cost of the coils by adjusting them to a given figure, such as 1 or 10 ohms.

Prof. W. CHANDLER ROBERTS read a paper "*On the Hardening and Tempering of Steel.*" He pointed out that few questions connected with the metallurgy of iron and steel are attracting more attention now than the relation between a metal and the gases it comes into contact with during manufacture. The carburisation of iron has long been of great interest, as shown by the work of Clouet at the end of last century, and that of Margueritte in 1865, who showed that though the conversion of iron into steel could be effected by contact with carbon even in the diamond form, it is nevertheless true that in the ordinary process carbonic acid plays a considerable part which had been overlooked. Graham's 1867 paper on the occlusion of gases by metals gave point to Margueritte's work by showing that carbonic oxide can penetrate to the centre of a mass of iron. It is introduced, in fact, at a comparatively low temperature, while a high temperature is necessary to enable the metal to appropriate the carbon and become steel. Metallurgists are now carefully investigating the effect of occluded gases in iron and steel. Prof. Roberts considered the point recently raised as to whether the hardening and tempering of steel might not be influenced by the occlusion or expulsion of gas. He described experiments by which he proves that as steel hardens when rapidly cooled *in vacuo*, gases could not play any part in the tempering. He also dwelt on the precautions necessary to keep the metal in the experiment free from occluded gas. He then showed that Bergman (to whom we owe our knowledge that the difference between wrought-iron and steel depends on the carbon in the latter) showed in 1781 that fixed air could give up its carbon to iron, and he concluded by showing that Reaumur, so long ago as 1722, actually employed the Toricellian vacuum in experiments on the tempering of metal, the metal being placed red-hot in a highly rarefied atmosphere. Reaumur also had a clear view of the effect a gas might have on the physical properties of a metal—a point of great interest to physicists in general.

Prof. HUGHES expressed the opinion that temper was not due to absorption of hydrogen, but to the absorption of carbon in the iron.

Mr. STROH found that an electrically fused steel contact was glass hard.

Prof. GUTHRIE exhibited a steel chain which he had beautifully blackened by dipping in fused nitre. The skin might be useful in the arts, and was perhaps analogous to that produced by Barff's process.

Lord Rayleigh, Mr. Walenn, Mr. Lecky, Dr. Coffin, Prof. Ayrton, and others continued the discussion.

Mr. Grant then read a paper on Curves of Electromagnetic Induction, which he had traced out by means of primary and secondary coils sliding on frames, so as to take different positions with respect to one another. The paper was illustrated by experiments and diagrams.

Prof. Reinold then read portions of a paper by Prof. S. P. Thomson "*On the Opacity of Tourmaline Crystals.*" The optical and electric properties of these crystals are related, and Prof. Thomson propounds an explanation of this connection based on the late Clerk-Maxwell's electromagnetic theory of light. The full paper will be published in the journal of the Society.

CORRESPONDENCE.

THE ESTIMATION OF PEROXIDE OF HYDROGEN.

To the Editor of the Chemical News.

Sir,—I regret that Mr. Em. Schöne has, in his recent communication to your journal, committed himself to statements against which I feel it necessary only to record an emphatic protest.

As, under the circumstances, I cannot continue the discussion with Mr. Schöne, permit me to add that I abide by every word I have written upon the subject in question, and am fully prepared to stand or fall by my investigations.—I am, &c.,

C. T. Kingzett.

17, Landsdowne Road, Tottenham, N.,
June, 8, 1881.

THE BAROMETER PUMP.

To the Editor of the Chemical News.

Sir,—Mr. James Johnstone's patent of May, 1847, is granted for a contrivance which Mr. Johnstone calls in his patent a "barometer vacuum *pan*," and which he now calls, after an elapse of thirty-four years, a "barometer *pump*." It is a vacuum pan, to the bottom of which a long tube has been attached, closed at its lower end by a tap. By opening occasionally this tap the sugar solution previously concentrated in the vacuum pan is allowed to escape without the admittance of air into the vacuum pan—owing to the length of the discharge-tube. This tube is not intended to create, or help to create, the vacuum in which the solution of sugar was concentrated, but merely to maintain the vacuum, created in the ordinary way and fashion of 1847.

As Mr. Johnstone removes no air from his vacuum pan by means of his patent *tube-tap*, it appears (from the evidence he has furnished) that he is not the inventor of an exhauster or an air-pump of any kind. A *tube-tap*, moreover, is neither a barometer nor an air-pump, and a barometer pump (known long before 1847) does not belong to the class of air-pumps which Dr. Sprengel introduced in 1865.—I am, &c.,

C.

June 11, 1881.

THE BAROMETER PUMP.

To the Editor of the Chemical News.

Sir,—Mr. Johnstone appears to have applied the principle discovered by Torricelli in 1643, and developed by Pascal, just as Bunsen has applied the principle discovered by Sprengel, which is totally different from the Torricellian. Mr. Johnstone is totally wrong, and misses his way when he says Dr. Sprengel "*followed his footsteps*," for, in point of fact, the instrument Johnstone used is no *pump* at all, but merely a *running-off pipe* (*vide* Chemical News, vol. xxxix., p. 256, and vol. xl., p. 42). Down this "*barometer pipe*," as W. Johnstone himself terms it in the former letter, the sugar solution flows by its own weight. The principle Dr. Sprengel discovered is a new one, and constitutes a means of continuous exhaustion with a quite small and simple apparatus, but the Torricellian principle, on which Johnstone's apparatus depends, can never be in like manner applied. Thus, so far from Mr. Johnstone being the father of "*barometer pumps*," it merely comes to this, that he is the "*father*" of a *running-off pipe* of a special kind, though all will admit the application of the principle of the Torricellian barometer to the maintenance of his vacuum to be highly ingenious.—I am, &c.,

Verax.

WOOD-GAS.

To the Editor of the Chemical News.

Sir,—In the Chemical News, vol. xliii., p. 57, an abstract of a paper on wood-gas gave its composition as hydrogen 5·4 per cent, marsh-gas 44·1 per cent. The numbers should be reversed. I send a copy of the original paper read before the American Chemical Society.

By modifications in the process since that date, the yield of gas per cord of wood has been increased to nearly 80,000 cubic feet. The amount of carbon dioxide in the crude gas has been so reduced by these changes as to be only 5 per cent.—I am, &c.,

Charles A. Doremus.

Bellevue Hospital Medical College,
New York, May 28, 1881.

THE ESTIMATION OF PHOSPHORUS IN STEEL.

To the Editor of the Chemical News.

Sir,—Notwithstanding the skilful manner in which Mr. Arnold trails the red herring across the scent, I must decline his invitation. Mr. Arnold shifts his ground with each letter, and so, to render the point at issue between us plainer, I propose to recapitulate the steps of the controversy.

1. Mr. Arnold writes a paper which, if it means anything, is intended to prove that Eggertz's molybdic acid method of estimating phosphorus in steel, gives results below the truth. Mr. Arnold states, that complete precipitation can only be effected by boiling the solution, a plan which brings down excess of molybdic acid and necessitates re-solution in ammonia and conversion of the phosphorus into ammonio-magnesium phosphate, for the complete precipitation of which Mr. Arnold allows one hour.

2. I object that Mr. Arnold's failure to obtain accurate results by the molybdic acid method was due to his neglect of certain well-known precautions.

3. Mr. Arnold replies in effect; "Yes; Eggertz's method gives correct results, if the operator exercises proper care; but that is not possible in practice, and my method is quicker and gives accurate results."

4. I object that the method suggested by Mr. Arnold has been previously proposed by several other chemists, and that it presents the great disadvantage that only 13·9 milligrms. of magnesium pyrophosphate would be weighed instead of 234·9 of the yellow precipitate.

5. Mr. Arnold writes in his last letter, "the question is not which method gives the heavier precipitate, but which is the more accurate. The solubility of the pyrophosphate in the mother-liquid would make the results low, whereas they come out higher than the molybdate."

This is arguing in a circle. Mr. Arnold says Eggertz's method may be correct if properly managed. I cannot afford the time to attend to the conditions of accuracy, and as I work it I get low results; that is, I get lower than those by the magnesia method.

Every chemist knows and has used the method of determining phosphorus described by Mr. Arnold, but few would have the boldness to assert that the precipitation of the ammonio-magnesium phosphate was complete in *one hour*, when the *total quantity* of phosphorus to be determined was only such as would yield 0·0139 grm. of pyrophosphate. Yet if a longer time be required for precipitation, where is Mr. Arnold's sole remaining position,—that the method is more *rapid* than that of Eggertz? What correction does Mr. Arnold make for the solubility of his magnesium precipitate in the mother-liquor?—I am, &c.,

PHOSPHORUS.

June 11, 1881.

PS. Would Mr. Arnold be surprised to hear that estimations of phosphorus by molybdic acid are constantly made in certain laboratories in less time than Mr. Arnold prescribes for the deposition of the magnesia precipitate?

[This correspondence must now cease, as far as our columns are concerned.—*Ed.* C.N.]

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences. No. 19, May 9, 1881.

Diazo-Benzol Nitrate.—MM. Berthelot and Vieille.—A thermo-chemical examination of this compound which has been proposed as a substitute for the fulminates in the manufacture of detonators. It explodes if struck, rubbed, or heated above 90°, and even below this point it undergoes a gradual decomposition. It is gradually decomposed by the action of light, and is at once destroyed on contact with water, yielding nitrogen, phenol, and other products.

A New Derivative of Nicotine, obtained by the Action of Selenium.—A. Cahours and A. Etard.—The product obtained, into which the selenium does not enter, is a hydrocollidine, a limpid amber-coloured liquid, boiling at 205°, lighter than and insoluble in water, but soluble in alcohol, ether, and dilute acids.

Densities of Liquefied Oxygen, Hydrogen, and Nitrogen in Presence of a Liquid without Chemical Action upon these Simple Bodies.—L. Cailletet and P. Hautefeuille.—M. Pictet has drawn from the numerical data of his researches on the liquefaction of oxygen an approximate value for its density in the liquid state. The authors have made their observations upon liquefied carbonic acid, mixed respectively with liquefied oxygen, hydrogen, and nitrogen. The densities of these bodies when liquefied, taken at two temperatures, but at one and the same pressure, enable it to be established that their coefficients of expansion differ so little that the densities have the same respective proportion at 0° and at −23°. The densities have therefore been taken at temperatures and pressures at which these liquids are mutually comparable, and they render it possible to calculate the relations of the atomic volumes of these three bodies. These atomic volumes are 17 for oxygen, 30·3 for hydrogen, and 31·8 for nitrogen if we divide each of the atomic weights of these bodies ($O=16$, $H=1$, $N=14$) by its density at −23°, *i.e.*, 0·89, 0·033, and 0·44. Oxygen, hydrogen, and nitrogen when gaseous, deviate very unequally from the law of Mariotte at the pressures employed in the authors' experiments (275 to 300 atmospheres), and there exist no longer, under these conditions, simple relations between the atomic weights of these gases and their densities. But if a change of the state of aggregation is determined by a reduction of temperature it is found that the atomic volume of a body is a datum showing a positive relation between its density and its equivalent weight. If, as M. Stas holds, we cannot rely upon a law of condition for the determination of the true relation of the atomic weights, the atomic volumes lose their importance. But the atomic volumes which the authors have calculated deserve attention, even from this point of view, as furnishing numbers which are sensibly equal when they are not doubles of the atomic volumes assigned to their isomorphs. The atomic volume of nitrogen at −23° is about double that of phosphorus; these volumes would be about equal if we took the atomic weight of phosphorus as 62·8. The atomic volume of hydrogen at −23° is a little more than double the atomic volume of magnesium to which M. Dumas has already compared hydrogen. If experiment shows that magnesium in the state of vapour has a density forty-eight times greater than that of hydrogen, the anomaly observed in the nitrogen group, both in the gaseous and the liquid state, and ascribed to the splitting up of the molecule of nitrogen, would be repeated with the same characters in the group of which hydrogen is the first term. The atomic volumes of liquefied oxygen, hydrogen, and nitrogen differ much, as might be expected, from those which have been deduced from the molecular volumes of compounds into which these elements enter. M. Kopp has given several atomic volumes for these bodies. His numerical determinations, combined with those which the authors have just completed, will render it possible to explain the correlative contractions of the principal compounds of these bodies, whether among themselves, or with those of the other elements which are known in the liquid or in the solid state.

Performance of Secondary Batteries.—E. Reynier.—The performance is 81 per 100 of the initial force.

Certain Actinometric Measurements made in the Alps in 1880.—P. Puiseux.—The observations show that the activity of vegetation is proportional to the actinometric degrees measured.

Action of Light upon Phosphorescent Bodies.—M. Clémandot.—The author maintains that phosphorescence is a purely physical phenomenon, due to a vibratory action exercised chiefly by the blue ray of light. He connects these phenomena of vibration in phosphorescent bodies with those which light occasions in organised bodies.

Action of Carbonic Acid upon Baryta and Strontia. F. M. Raoult.—Baryta and strontia absorb carbonic acid very eagerly and become incandescent, but as is the case with lime the neutral carbonate cannot be reproduced by direct synthesis.

Products of the Action of Phosphorus Perchloride upon Acroleine.—P. Van Romburgh.—The author has satisfied himself of the absence of dihydrochloric glycide among the products of the reaction.

Die Chemische Industrie. No. 11, November, 1880.

Causticising Soda Lyes.—Dr. K. W. Jurisch.—In causticising revolver black-ash lye 11·8 cwts. lime are required per ton: for hand-worked black-ash $10\frac{3}{4}$, and for so-called red liquor, which contains 40 parts of caustic, only 8·9 cwts. In practice these low theoretical numbers are rarely reached, and 12 cwts. lime are used in producing a ton of caustic soda at 70 per cent. If sufficient agitation is not kept up during the reaction a much larger excess of lime is required to ensure sufficient causticity. A lye of sp. gr. 1·100 is the strongest that can be causticised in the ordinary manner without loss in the shape of a compound of soda and lime. This compound is produced to a very small extent only if lyes of 1·16 to 1·18 sp. gr. are causticised at 140° to 145° according to E. W. Parnell's process. A very considerable saving in coal is thus effected.

Technical Chemical Notes.—Dr. G. Lunge.—1. Decomposition of Sodium Sulphate by Lime.—Tessie du Motay asserted that at a pressure of 2 to 20 atmospheres from 75 to 80 per cent of the sulphate could be decomposed. Recent experiments show that a tolerably complete decomposition is obtained only at high pressures and with such excessive dilution as to put a practical utilisation of the process out of the question.

2. Decomposition of Sodium Sulphate with Barium Carbonate.—Experiments made both with precipitated carbonate and with powdered witherite at a boiling heat without pressure, but with reflux of the evaporating water, show that an almost complete decomposition is effected. Of precipitated carbonate the quantity required is 1½ equivs. and of witherite at least 2 equivs.

3. Decomposition of Soda Saltpetre with Carbonate of Lime as proposed by Waly and Lieber.—Experiments prove that by the use of 2½ equivs. calcium carbonate, it is possible to convert the nitre entirely into caustic soda, and recover the greater part of the escaping nitric acid. The practical difficulty lies in the rapid destruction of the vessels.

4. Behaviour of Solutions of Chlorates when Heated.—Neither in the calcium nor the potassium salt does any loss of oxygen take place on boiling. Hence an addition of potassium or calcium chloride at the beginning of the process is not necessary, and there is no need for an anxious avoidance of a high temperature in later stages of the operation.

5. Preparation of Potassium Ferricyanide by means of Lead Peroxide.—The conversion is not practicable on Böttcher's method, when the solution is rendered strongly alkaline. It is necessary to follow Schœnbein's process, saturating the liberated alkali as fast as formed by the continuous introduction of a current of carbonic acid. The yield is good, the quality unexceptionable, and there are no green by-products.

6. Preparation of Benzoic Acid from Benzo-trichloride and Water.—The conversion is complete on boiling benzo-trichloride with water in a reflux-cohobator for four hours.—*Dingler's Polyt. Journal.*

No. 12, December, 1880.

A New Double Salt of Potassium and Magnesium Sulphate.—Dr. H. Precht.—The formula of the new salt is $KSO_42MgSO_4H_2O$.

The Ultramarine Question.—K. Heumann.—The author criticises H. Endemann's constitution-formula for ultramarine, as given in the Chemical News, vol. xlii., p. 204, and pronounces it devoid of all scientific foundation.

Manufacture of Citric Acid.—J. Casteo.—The process is described at very considerable length.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin.
Vol. 13, No. 11.

A New Cymol Occurring in Light Resin Oil.—W. Kelbe.—This compound is obtained on purifying light resin oil with soda-lye, and submitting it to fractionated distillation. It is a colourless, strongly refringent liquid, boiling between 173° and 175°. On oxidation with potassium permanganate it yields isophthalic acid. The author regards it as meta-iso-cymol.

The Formation of Hypo-xanthine from the Albumenoids.—G. Salomon.—Not adapted for useful abstraction.

Influence of the Access of Oxygen upon Fermentation.—A. Mayer.—The author finds that free oxygen has no perceptible direct influence upon fermentation. He observes that under circumstances not yet perfectly determined, organic acids and their salts have a very remarkable influence upon fermentation.

Suberic Acid of Oxidation.—F. Ganther and C. Hell.—A very complete account of the salts of this acid.

Constitution of α-Disulpho-toluolic Acid.—Peter Claesson and H. Berg.—In order to decide this question the authors prepared the isomeric toluol-mono-sulphonic acids.

Determination of the Extractive Matter in Wine.—E. A. Grete.—The irregularity in the results hitherto obtained is due to the volatility of glycerin at 100°. The author heats 10 c.c. of the sample in a small platinum capsule in order to expel carbonic acid, and adds 10 to 20 c.c. of accurately titrated baryta-water in order to neutralise the acids, and to fix the volatile matters as far as possible. The whole is then dried up on the water-bath, and afterwards evaporated in a drying-niche at 110°, till the weight becomes constant. 1. The quantity of the baryta solution required to neutralise the acids of the wine is found by direct titration. In the first place, for every molecule $Ba(OH_2)$ consumed BaH_2 must be deducted. 2. Another part of the c.c. of baryta solution added becomes converted into barium carbonate during the evaporation, and must be deducted. Its quantity is found by subtracting the c.c. of solution No. 1 and No. 3 from the total quantity which has been added. 3. The third part of the baryta solution remains in the weighed residue in the state of BaO combined with certain constituents of the extract. This quantity is determined by dissolving the extract in water, and carefully titrating the caustic baryta present. This is then deducted as No. 3 from the entire weight.

Process for the Preparation of Tartaric and Uvic Ether.—R. Anschütz and Amé Pictet.—The authors have obtained and examined dextro-tartaric dimethyl-ether, dextro-tartaric diethyl-ether, dextro-tartaric dinormal-propyl-ether, uvic dimethyl-ether, diacetyl-dextro-tartaric anhydride, dibenzoyl-dextro-tartaric anhydride, and diacetyl-uvic anhydride.

Certain Derivatives of Phenanthren.—R. Anschütz and J. von Siemenski.—An account of the bromo-phenanthren-mono-sulphates of potassium, silver, and barium.

Critique of Meyer's Method of Determining Vapour-Densities.—Otto Pettersson and G. Ekstrand.—The authors maintain that the accuracy of V. Meyer's method is not beyond doubt. They have made comparative determinations of the vapour-densities of a number of compounds by the methods of Meyer and of Dumas at exactly the same temperatures, and have found that the former process yielded invariably smaller and less mutually concordant results than that of Dumas, the latter of which agreed almost perfectly with the figures calculated by W. Gibbs in accordance with theory. They point out two sources of error in Meyer's process,—the condensation of air on the surface of the vessel of glass, porcelain, or platinum, in which the substance is enclosed, and the condensation of air in the substance itself, an error which cannot be compensated, since organic fluids absorb air in very different proportions.

Application of the Method of Dumas to the Examination of the Gaseous Condition of Anhydrous and Hydrated Formic and Acetic Acids.—Otto Pettersson and G. Ekstrand.—This paper cannot be intelligibly reproduced without the accompanying figures.

Photo-chemical Behaviour of Silver Bromide in Presence of Gelatin.—H. W. Vogel.—The author contrasts the behaviour of gelatin in presence of silver bromide with that of collodion.

Action of Bromine upon Dichlor-hydrine and the so-called Propyl-phycite.—A. Claus and R. Lindhorst.—In the action of bromine upon dichlor-hydrine the central carbon atoms are first oxidised to acetone, and that there is no formation of a body of the composition of the hypothetical brom-dichlor-hydrine from which a phycitoid compound might be derived.

Bromine Derivatives of Nicotin.—R. Laiblin.—The author has prepared and examined brom-nicotin,—

$$C_{10}H_{12}N_2Br_2.$$

MISCELLANEOUS.

Society of Chemical Industry.—We beg to call the especial attention of our readers to the approaching General Meeting of the Society of Chemical Industry, as announced in our advertising columns. Among the papers to be read, those on "Recent Legislation on Noxious Gases," and "The Patent-laws as Applied to Chemical Inventions," will have a claim on the serious attention of all persons engaged in chemical manufactures,—the more, as further legislation, in both directions, is imminent.

NOTES AND QUERIES.

*** Our Notes and Queries column was opened for the purpose of giving and obtaining information likely to be of use to our readers generally. We cannot undertake to let this column be the means of transmitting merely private information, or such trade notices as should legitimately come in the advertising columns.

Arsenic from Tin Ore.—Can you inform me in what work or publication I can find the latest improvements in the process for obtaining commercial arsenic from tin ore, which contains 35 per cent of arsenic, and is, therefore, worth working for the arsenic itself?—A READER.

MEETINGS FOR THE WEEK.

WEDNESDAY, 22nd.—Geological, 8.
THURSDAY, 23rd.—Royal Society Club (Anniversary), 6.30.
FRIDAY, 24th.—Quekett, 8.
SATURDAY, 25th.—Physical, 3. "Apparatus for Lecture Experiments on Current Induction," W. Grant. "Results of Experiments with a Modification of Bunsen's Calorimeter," Prof. Balfour Stewart and W. Stroud.

THE CHEMICAL NEWS
AND
JOURNAL OF PHYSICAL SCIENCE.

Edited by WILLIAM CROOKES, F.R.S.

CHARGES FOR ADVERTISEMENTS.

	£	s.	
Five lines in column (about 10 words to line)	0	3	6
Each additional line	0	0	
Whole column	1	15	0
Whole page	3	0	0

A reduction made for a series of insertions

Cheques and Post-Office Orders, crossed "London and County Bank," payable to the order of William Crookes.

BOY COURT LUDGATE HILL LONDON, E.C.

IRISH HILL BAUXITE (Alum Clay).

The IRISH HILL MINING CO. are now, and always have been, the LARGEST PRODUCERS OF THIS CLAY, of Superior Quality, and supply the Manufacturers of Alum, Sulphate of Alumina, and Alum-Cake, of the United Kingdom, America, and the Continent, almost exclusively.

Analysis by John Pattinson, Esq.

	Dried at 212° F.		
	Gertrude (extra qual.)	1st Quality.	2nd Quality.
Alumina	59·00	53·83	52·00
Peroxide of Iron	0·47	1·57	4·57
Silica	18·00	8·67	12·00
Titanic Acid		5·80	6·20
Lime, Magnesia, Potash, Soda, and Sulphuric Acid	0·23	0·83	1·14
Combined Water	22·30	29·27	24·00
	100·00	99·97	99·91

Our MINES, DRYING KILNS, and GRINDING MILLS are situated very close to the Shipping Ports of BELFAST and LARNE, and adjacent to Railways running alongside both Steamers and Sailing Vessels at both Ports, from either of which shipping is abundant and cheap, therefore we can guarantee Regular Delivery as Buyers require it, and are prepared to quote prices f.o.b. c.i.f., or delivered at any Port, in Bulk or Bags, Lump or Ground.

GEO. G. BLACKWELL, *Managing Director.*

Richmond Buildings, 26, Chapel St.,
Liverpool.

Established 1798.

ROBERT DAGLISH & CO.,

ENGINEERS, BOILER AND BRIDGE MAKERS, MILLWRIGHTS,
BRASS AND IRON FOUNDERS.

Manufacturers of every description of Condensing, or High-pressure Blowing, Pumping, Rolling, Winding, and Patent Steam-engines, of any required power, for Irrigating, Draining, Mining, Rolling Mills, or Water Works purposes, and Manufacturers of every description of Chemical, Colliery, Copper Ore, Gold Mining, Glass, and Rock-salt Machinery.

Black-ash Revolving Furnaces of the Most Approved Type.

Bessemer Steel-Rail Plant.

Compressing-Engines for Collieries, Iron Works, and Weldon's Patent Bleaching-Powder Process.

Caustic, Chlorate, Decomposing, Nitre Nitro-Glycerine, Iodine Potash, Sulphur, Acid, and Oxalic Pans.

Gas Producers Patent for Heating and other Purposes.

Pyrites Burners for Irish, Norwegian, and Spanish Ores of Improved Construction.

Patent Rousing Machinery for Brewers.

Retorts, Acid, Gas, Iodine, Nitric, Nitre Nitro-Glycerine and Vitriol Refining.

Steam Superheaters improved for Oil, Tar, and Resin Refining.

Steam Sulphur Melter.

Stills for Oil, Resin, and Tar.

Wheels, Bevel, Mitre, and Spur Moulded on the Shortest Notice by Patent Machinery.

Makers of Mactear's Patent Carbonating Furnace, Jones and Walsh's Patent Sulphate of Soda Furnace, Parnell and Simpson's Patent Causticiser, and Kynaston's Patent Alum Plan

Lists sent on Application.

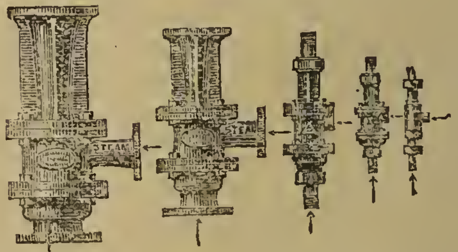
Photographs, Plans, and other information supplied on receipt of Order.

ST HELEN'S ENGINE, BOILER, AND BRIDGE WORKS
AND FOUNDRY,
LANCASHIRE.

BAILEY'S
LOW LIFT STEAM JET PUMPS,

(HALLAM'S PATENT)

For Lifting Water from Wells, Steam Ships, Tanks, Rivers, Reservoirs, &c.



The three smaller ones are all Gun Metal.

Cast Iron with Gun meta Fittings.

Prices for Heights of not more than 40 ft., at 30 lbs. Pressure

Please note these when ordering,	6	5	4	3	2	1	0	
Bore of Water Delivery Pipe in inches	4	3	2	1½	1	¾	½	½
Bore of Steam Pipe	2½	1½	1¼	1	¾	½	⅜	¼
Delivery in gals. per hour at 30 lbs. prssre.	8000	5000	2500	1500	800	500	200	100
Price .. £	20 0	12½	10 0	7 10	4 10	3 3	2 2	1 10

W. H. BAILEY and CO., Engineers, &c.,
ALBION WORKS, SALFORD, MANCHESTER.

TETRACHLORIDE OF CARBON.
BISULPHIDE OF CARBON.
CHLORIDE OF SULPHUR.

JESSE FISHER & SON,
Phœnix Chemical Works Ironbridge.

THE CHEMICAL NEWS.

Vol. XLIII. No. 1126.

ON A CURIOUS ACTINIC PHENOMENON.

By Dr. T. L. PHIPSON, F.C.S., &c.

Having seen a paragraph in several English and Foreign periodicals relating to a novel actinic phenomenon discovered by me some time ago, it will be, perhaps, expedient to publish all I know at present upon this singular occurrence. In the first place, it is necessary to state that the phenomenon in question was first noticed by my friend, Mr. Thos. Griffiths, F.C.S., who called my attention to it more than a year ago, and requested me to investigate the cause of it.

The first observation was that a gate post painted white by means of a new white pigment having a zinc basis appeared black all day and white all night, turning black again soon after sunrise, *et ainsi de suite* for any number of days.

The white pigment was prepared by precipitating a solution of sulphate of zinc by another of sulphide of barium, and its analysis gave me the following results:—

Loss by calcination..	1·62
Sulphate of baryta	41·50
Sulphide of barium	1·02
Protoxide of iron	2·12
Oxide of zinc	16·30
Sulphide of zinc	37·44
Lead, arsenic, manganese, &c. ..	traces
	100·00

I found that when this white powder was spread upon a piece of paper and exposed to the direct rays of the sun, it became fawn coloured, brown, and finally a dark slate colour in the course of about twenty minutes. When in this state it was placed in darkness it became white again in 2½ to 3 hours' time.

The phenomenon was doubtless due to the use of sulphide of barium in the preparation of the pigment; for specimens made by another process in which no sulphide of barium is used did not show it at all.

The property possessed by sulphide of barium of becoming phosphorescent after insolation has been long known, but the explanation of this curious phenomenon is no further advanced now than when my little volume "Phosphorescence, &c.," appeared in 1862, unless the recent interesting electric experiments by Mr. Crookes, F.R.S., supply the key to the enigma.

In the present case, however, no phosphorescence is observed when the insolated pigment is carried into a dark place during the time it is undergoing colouration by the direct influence of the solar rays.

Another curious fact soon struck me, namely, that if a piece of glass were laid over the white pigment when exposed to the sun, it did not darken, however thin the glass might be: whilst the half of the specimen which remained uncovered took a very dark slate colour in about half-an-hour, that which was protected by the glass was nearly as white as at first, and it took from 4 to 8 hours' exposure to direct sunlight to give to this portion under the glass a very slight fawn-colour.

Of course these phenomena could not be due to any compound of silver; nevertheless, the specimens were tested for silver, and with great care, but without the slightest result. In fact, no actinic substance has been met with that will *darken in the sunshine, become white again in the dark, and will not darken under a sheet of ordinary window glass.* It was hinted that I was dealing with a new element (to be called "Actinium"); but the continuation of my experiments lead me to believe that the phenomena described above may probably be due to the presence of *sulphide of barium* and *protoxide of iron* in the specimens, rather than to some unknown metal.

I observed that the dark slate coloured product was immediately soluble in cold acetic acid (as sulphide of iron is); and if the dark colour be due to the production of sulphide of iron, the return of the pigment to its original white tint when placed in darkness for some hours, may be owing to the gradual oxidation of this sulphide of iron and consequent disappearance of the dark colour.

The baryta soluble in acid found in the analysis is calculated as sulphide, and the iron as protoxide (as it exists in the *proto* state), but the pigment may really contain some compound oxy-sulphide of zinc, iron, and barium, which has the property of turning black in the sunshine by the carrying of sulphur on to the iron during insolation; and the black sulphide disappearing by gradual oxidation when the stuff is placed in the dark would account for its reassuming its white tint.

I find also that a strong calcination, with free access of air, destroys, or considerably hinders, the production of the actinic phenomenon. I have also observed that although the pigment will retain this property of darkening in the sunlight for more than a year, some specimens have lost this property in a few months; and a gate post painted white, after darkening, in the manner above mentioned, for the space of several days, will at last remain white.

All this points to the probability of the above explanation, but the matter is still under investigation.

OCCURRENCE OF A NODULE OF CHROMITE IN THE INTERIOR OF COMPACT METEORIC IRON FROM COHAHUILA.

By J. LAWRENCE SMITH, Louisville, Ky.

The masses of iron from Cohahuila that I have designated as the Butcher Meteorites (to distinguish them from other meteorites from the same locality), have already afforded me several most interesting and novel results; among them, concretions of arragonite on the exterior (doubtless formed after their fall from surrounding conditions), and, more particularly, the new and interesting mineral, daubréelite, concreted in the interior of the troilite nodules that exist in this iron. A great number of sections have been cut, and daubréelite is always found with its well defined characteristics.

Recently I have had made two additional large sections. They have furnished, however, but few nodules. One of these was a well-defined symmetrically oval nodule, 17 m.m. by 12 m.m., its diameters situated 6 centimetres from the exterior surface, compact solid iron intervening between the surface and the nodule.

I was at once struck with its being different from any nodule I had yet observed in meteoric iron. There was no troilite in it, and although black it was not graphite; so that I supposed it might consist entirely of daubréelite. But its lustre was more vitreous than this last mineral. On examining carefully with a glass, I found in the black material a few particles of a translucent mineral, some particles of which were almost colourless, and one or two of a greenish hue (doubtless magnesian silicate); and, besides, there were a few specks of iron only traceable by the magnet.

The nodule was virtually a black granular mass. As stated, it was first taken for daubréelite. The smallest particle rubbed fine and fused with borax gave the intense green of chrome; but, to my surprise, when the powder was heated in nitric acid over a water-bath, not the slightest impression was made upon it, showing that it was not daubréelite, which is soluble in nitric acid, leaving a dark green residue. Heating it in fused carbonate of soda in no way changed its insolubility in acids. These reactions convinced me that I had *chromite;* and on fusing 150 milligrms. of the finely pulverised mineral with ten times its weight of bisulphite of soda, it was thoroughly attacked, but not dissolved. On treating with water, and fusing the residue with carbonate of soda and nitre, proceeding with the analysis as is usual in the case of chromite, there was obtained—

Chromic oxide	62·71	—Cr_2O_3
Ferrous oxide	33·83	—FeO

the iron oxide being in the solution from the fused mass, after treatment with bisulphite of soda. The composition thus found is that of chromite. Traces of magnesia, cobalt, and silica were detected: the magnesia and silica doubtless came from the siliceous mineral already referred to, which is either enstatite or olivine.

The result of these observations, then, is to establish the existence of a new mineral concretion in the interior of meteoric iron: for while chromite has been known to be associated with meteorites, this is the first instance of its having been found embedded in this manner in the interior of meteoric iron. The fact thus increases the interest of the Butcher meteorites, which have furnished such beautiful and distinguishing concretions of two chrome minerals.

I should state that some of the particles of chromite, under the microscope and with very intense light, are feebly translucent, and have a dark reddish purple colour. This translucency of chromite has been observed by the Assistant of the Professor of Geology in the College of France. The name of this assistant I do not now recollect, and I cannot now place my hands on the results of his researches in this direction.

ON THE
DECOMPOSITION OF CYANIDE OF MERCURY AND CYANIDE OF SILVER BY HEAT.

By E. MAUMENÉ.

IT is well known that cyanide of mercury—in which the cyanogen appears to play the part of a simple body—is far from being decomposed by heat, like mercuric oxide, and giving $C_2NHg = C_2N + Hg$. There remains in the tube a brown residue, considered to be $(C_2N)x$; but nobody has yet found the value of x. What is the origin of this body?

The "Théorie Générale de l'Action Chimique" gives—

$$\boxed{M} \quad n = \frac{100}{26} = 3{\cdot}85,$$

a number which may be corrected to 4·00.

$$4(C_2NHg) = (C_2N)_4Hg + 3Hg.$$

The 3Hg which remain free can only volatilise.

Experiments made on an oil-bath give results absolutely concordant. Up to 320° nothing takes place, but at this point vapours of mercury are given off, and condense in the tube without the slightest trace of cyanogen. The tube should be plunged in melted solder. Up to 400° nothing but Hg is vapourised; at a little over this temperature (as Troost and Hautefeuille observed in sulphur vapour) the $(C_2N)_4Hg$ is destroyed, and cyanogen is liberated abundantly. The para-cyanogen *in this case* has for formula $(C_2N)_4$.

We can easily foresee a similar decomposition for cyanide of silver, and confirm it by experiment.

$$\boxed{M} \quad n = \frac{108}{26} = 4{\cdot}15,$$

corrected to 4·00. $4(C_2N + Ag) = (C_2N)_4Ag + 3Ag$, 3Ag remaining free but unable to disengage itself. Mercury mixed with the cooled residue at the moment when the first bubble of cyanogen appears, dissolves 3Ag. We know that nitric acid also dissolves the Ag set free, and that, even after having exhausted the calcined matter, the residue contains 40 per cent of silver. This acid, mixed with four times its weight of water, is able to separate the $(C_2N)_4Ag$ from 50 per cent of silver, confirming the "Théorie Générale." The cyanides decomposable by heat give decidedly analogous results.

ON THE
ACTION OF NITRIC ACID ON METALS.

By E. MAUMENÉ.

TIN left in very weak nitric acid produces nitrate of tin and ammonia; this is a well-known fact. But nobody has given an exact equation of this reaction. With the intention of proving this fact to my class I performed the following experiment:—

$$NO_5,(HO)_5 = 99 \text{ gr., whose volume } \frac{99}{1{\cdot}361} = 72{\cdot}74$$

$$\text{And } 5HO \quad = 45 \text{ ,, ,, ,, } = 45$$

$$\text{Making dilute acid .. .. .. } \quad 117{\cdot}74$$

$$\text{The atomic volume of tin being } \frac{59}{7{\cdot}34} = 8{\cdot}04$$

$$\boxed{C} \quad n = \frac{117{\cdot}74}{8{\cdot}04} = 14{\cdot}64,$$

taken as 14·00. The reaction ought to be—

$$14Sn + NO_5(HO)_{10} = 8SnO + 6Sn + NH_3 + 7HO.$$

In other terms, if we could realise two layers extremely thin, the action would only give protoxide of tin and ammonia.

In the gyratory apparatus, which I have described on page 510 in my "Théorie Générale," we get very near this condition; and, in fact, if we put it in very rapid rotation, and put in a little scrap tin, and slowly add the right quantity of acid, ammonia is formed in large quantities, and unites with the surrounding layer of acid without our being able to stop its complete neutralisation. But, on the other hand, an enormous quantity of protoxide of tin is formed and remains free, with all its properties quite evident. Thrown on a filter after separating the solution of ammonic nitrate, which is quite free from metallic tin, it produces with nitric acid a lively disengagement of NO_2, and its brown colour changes to pure white (SnO_2), &c. The solution of nitrate of ammonia, perfectly neutral, mixed with KO only gives a small quantity.

All the actions of metals with nitric and other acid, either diluted or not with water, can be calculated and verified by experiment in strict accord with the "Théorie Générale." The same holds good with all other chemical reactions, without exception. Exceptions do not exist in this theory.

Peptones and Alkaloids.—M. Ch. Tanret.—The author criticises the process lately given by MM. Brouardel and Boutmy, for distinguishing between the animal and the vegetable bases. The reduction of ferricyanide is certainly obtained, but it is not instantaneous, appearing only after the lapse of a few seconds. The reduction is produced almost in the same manner with crystalline ergotine, aconitine, and digitaline. It is instantaneous with eserine liquid, hyoscyamine, and amorphous aconitine, and ergotinine, as well as for morphine. Moreover, the list of vegetable alkaloids is far from being closed.—*Comptes Rendus.*

THE PRODUCTION OF PARAFFIN AND PARAFFIN OILS.*

By R. HENRY BRUNTON, M.Inst.C.E.

The discovery of paraffin wax, about 1830, was generally ascribed to Reichenbach, a German chemist; but, nearly at the same time, Dr. Christison, of Edinburgh, obtained a small portion of that substance from Rangoon mineral oil. The credit of producing this wax in merchantable quantities belonged, however, to Dr. James Young, of Kelly, in Renfrewshire. In 1848, Dr. Lyon Playfair directed Mr. Young's attention to an oozing of petroleum through a coal working at Alfreton, in Derbyshire. Mr. Young made arrangements to operate on this, and obtained a notable quantity of wax, as well as a light oil for burning and a heavy oil for lubricating purposes. After two years' successful working, the supply of petroleum at Alfreton ceased. Mr. Young then, as the result of numerous and protracted experiments, succeeded in obtaining, by the application of gentle heat to coal in close vessels, an oleaginous liquid similar in character to petroleum. Prior to this period (1848-9), the distillation of coal was conducted at high temperatures for the production of gas, Mr. Young being the first to attempt it with the ostensible object of obtaining liquid products. The process, the main feature of which was the gradual and gentle application of heat, was patented in 1850, and the patent was successfully maintained, nothwithstanding numerous attacks.

About the same time the Boghead or Torbanehill mineral was discovered, from which Mr. Young obtained 120 to 130 gallons of oil per ton. It was worked out in 1862, and paraffin oil had since been derived from the bituminous shales existent in the Coal Measures. From 80 to 90 per cent of that now worked was found in the counties of Linlithgow and Midlothian, and large fields were believed still to exist. The yield of oil from shale was only about one-fourth that from the Boghead mineral, yet the companies engaged in the trade were in a fair state of prosperity. There were eighteen establishments in Scotland for the manufacture of paraffin oil, using 1,036,000 tons of shale per annum, and producing 34 million gallons of oil. From this there were generally obtained, by the processes of rectification, 6 per cent of naphtha, 35 per cent of burning oils, 14 per cent of lubricating oils, and 9 per cent of solid paraffin, the remaining 36 per cent being lost. The lightest portion of the naphtha, known as "Gasoline," was employed for carburetting air for the illumination of country houses, &c.; other portions were used for burning in open-air lamps and for dissolving caoutchouc; while the heavy portion was applied for dissolving paraffin scale in the process of refining it. "Burning oils" were sometimes divided into lighthouse oil, which was of the greatest illuminating power and was the safest; No. 1 burning oil; crystal oil, which was No. 1 oil after treatment with acid and soda for removing its colouring matter and odour; No. 2 oil, and marine oil; but these varieties were generally mixed together and sold under various appellations.

By the Petroleum Act of 1871, the flashing-point, or temperature at which mineral oils should give off an inflammable vapour, was fixed as not under 100° F. This point was decided by the "open" test, but the results obtained by its means were variable and incorrect. By the Act of 1879 the test was made a "close" one, the apparatus designed by Professor Abel being employed; the "flashing-point" corresponding to 100° F., as made by the old test, being fixed at 73° by the "close" test.

The value of mineral oils as illuminants varied considerably. Lighthouse oil had been the subject of extended experiments; and whereas, when this was first used, a great advantage was apparent, both in consumption and illuminating effect, over vegetable oils, recent improvements in lamps made by Mr. James N. Douglass, M.Inst.C.E., and others seemed to have diminished, if not altogether to have destroyed, this superiority. But it was reasonable to suppose, owing to the larger proportion of carbon in mineral oil, that it should give better results if consumed to the greatest advantage: and, in consequence, the inference was that the lamps at present in use were not perfect in this respect.

The lubricating mineral oils had the defect of being deficient in body. The viscosity of an oil was tested by measuring the time a certain quantity took to pass through a tube, and by comparing this with rape oil as a standard. This being represented as 1000, mineral oils had a viscosity of from 250 to 400. They were therefore mixed with vegetable oils in certain proportions, and an addition of from 20 to 30 per cent was said to improve their lubricating properties.

Paraffin wax was of varied fusibility: that of a low melting-point was used in the manufacture of matches, and that having a higher melting-point chiefly for candles. Paraffin candles, which were made with a slight admixture of stearine, gave a clear smokeless flame, and a considerably superior light to sperm candles. It was claimed for paraffin that it was pure olefiant gas in a solid form, was converted into this gas when exposed to heat, and consumed without giving off any impurities.

The manufacturing processes for conducting the distillation of shale, introduced by Mr. Henderson, of the Broxburn Oil Works, Linlithgowshire, had led to the production of an oil of 1d. per gallon greater value, with an increased yield of ammonia, and at a saving of 1s. 6d. per ton, in fuel and maintenance of plant, on the shale dealt with. Mr. Henderson's retorts were placed in an oven above the combustion-chamber, and were not in direct contact with the fire. The carbon remaining in the spent shale was utilised, this being consumed as fuel for the retort, and by its slow combustion an equable temperature of about 800° F. was maintained. In the old form of retort the fuel used was coal, and the difficulty of maintaining a moderate temperature was so great that temperatures ranging from 1200° to 1500° were sometimes reached. The vapours from the retorts were led through a series of pipes, and partially condensed. The uncondensed portions were in some cases further subjected to condensation by pressure, or by a scrubbing process in a coke tower. The gas still remaining uncondensed was used as fuel. The ammoniacal liquor, which separated from the crude oil, was placed in boiler-stills, and the steam blown through sulphuric acid for the production of sulphate of ammonia. By arresting the process before the formation of crystals in the "cracker" box, and allowing some time for the precipitation of the arsenic and iron, and afterwards effecting the crystallisation by means of the evaporation of the liquid, an excellent commercial salt was produced from sulphuric acid made from pyrites. The first step in the treatment of the crude oil was its distillation to dryness, when pure vesicular coke was left in the bottom of the stills. The oil was then subjected to an acid and alkali treatment, and was fractionally distilled, being divided into naphtha burning oil, and a heavy oil containing 30 per cent of paraffin scale. The burning-oil portion received another acid and alkali treatment, and was again fractionally distilled, when more naphtha was separated, as well as a heavy oil containing 10 per cent of a more fusible paraffin. The burning-oil then received a final treatment, and on distillation was divided into the different qualities already mentioned.

Naphtha was rectified by distillation and treatment, it being also separated into the different gravities required by consumers. The heavy oil, from the first stage of purification, was run into bags, which were squeezed in hydraulic presses, and in this way a portion of the scale was separated. The oil so squeezed out, as also the heavy oil from the second stage of purification, was cooled by being put over a drum refrigerated by ether-machines, to 18° to 20° F., and was again squeezed, when more scale was obtained. Different methods were adopted, both for

---

* Read before the Institution of Civil Engineers, May 31, 1881.

the separation of the scale from the cooled oil and for lowering it to the necessary temperature.

The paraffin scale was refined by being dissolved on three occasions in naphtha, again crystallised by cooling, and squeezed under hydraulic pressure. Its deodorisation was effected by blowing steam through it, when in a melted state, for sixty hours: it was then agitated with animal charcoal, and was run through a paper filter into suitable moulds. The oil, pressed from the paraffin scale, received certain chemical treatments and was fractionally distilled, being separated into the required gravities, the light portion being returned as burning oil, and the remainder becoming lubricating oil, of 865, 875, 885, and 890 gravities. Any paraffin scale which these might contain was further separated by being refrigerated and pressed as already described.

The tar from the acid treatments was heated in large tanks to about 150° to 200° F., and the dilute acid and oil in it set free. It was then consumed as fuel, either in the furnaces of the boiler stills or with the object of evaporating dirty water. The soda contained in the tar from the alkali treatments was recovered by a process devised by Mr. Galletly, a chemist in the employment of Young's Company at Addiewell, 50 per cent of the soda used being so recovered at a cost of about 3s. per cwt.

Owing to the demand for paraffin oils being principally in winter, large storage accommodation was necessary for the summer production. This was afforded by malleable iron tanks of 50,000 to 100,000 gallons each, as the oil only slightly affected that metal, while it had a rapid action on lead or zinc.

The Paper only professed to describe the mechanical means employed in the manufacture, and no attempt was made to explain the chemical principles involved.

ON THE VENTILATION OF HALLS OF AUDIENCE.*

By ROBERT BRIGGS,
Member of the American Society of Civil Engineers.

(Continued from p. 277.)

To many people it is a favourite belief that ventilation should be in some way effected by a natural process. Windows and doors and open fires are the limit of artifice to be endured, houses being *presumed* in lieu of caves. There may be a fireplace with its chimney in the category of *natural* apparatus, although this was as artificial and as abstrusely ingenious to our ancestors of five or six hundred years since as the best steam or hot water heating apparatus is to us to-day. Perhaps to quote from my former paper on moisture in air will be the best answer to such persons. "Clothing, houses, and fires are the means by which mankind is enabled to inhabit the earth. It is an artificial existence for an animal whose natural life would otherwise be limited to a small belt of the torrid zone, where the temperature never falls below 80 degrees, nor rises above 100 degrees." Fresh air will not be supplied naturally to a person in an audience hall, as one obtains it on a mountain top, at the sea-shore, or upon the deck of a vessel. Neither the currents nor the temperatures of the healthful breezes are admissible in the processes of *ventilation*, so that the natural supplies cannot even be simulated artificially. To meet the demand for health and comfort in the natural gregation of men, which is one of the conditions of advancement in civilisation, ventilation and warming must be effected with unnoticeable means and yet with positive results. Success in ventilation of halls can only follow the complete adaptation of mechanical appliances and apparatus, as well as of structural arrangements, to the ascertained wants and requirements of the individuals composing an audience. In all mechanical appliances that is simplest which most positively and directly effects the purpose in view; and in this matter of supplying air it may be claimed that the process of impelling it, when and where wanted, is at once the most certain and efficient, and that the fan (in its form of a rotating wheel with vanes for large uses) is the simplest and readiest machine for impelling air.

It will not be attempted at this time to discuss the theory of Rotary Fans. The fan itself will simply be accepted as one of the recognised appliances in the construction of ventilating apparatus, available with other mechanisms in established forms and defined types for American practice.

The fans most generally in use for the ventilation of large buildings in America have been derived, in all essential particulars of conformation, from those designed by the writer for the United States Capitol at Washington in 1855 and 1856. These particular fans were based upon a type given by M. Combes (in his "Aerage des Mines"), where the fan blades or vanes were placed upon the face of a disk, and the fan itself thus constructed was located in front of a circular opening in the wall of a building, the wall forming one side of the zone of blades, in opposition to the outer edge or face of the disc, which formed the other side. In this construction no case whatever is demanded for the fan, which receives its air through the central circular opening in the wall, and delivers its air at all points of the periphery into a large but close room, from which room the ducts for conveying air branch in any desired direction.

The heating and ventilating at the United States Capitol was under the charge of Major-General M. C. Meigs (then Lieut. U.S. Engineers), who selected this type of fan as presenting certain structural advantages for its employment. The study of the conditions of fan construction, which was devolved upon the writer, led to some modifications in the forms of blades, &c., as accepted by M. Combes, with which changes these fans were employed in the ventilation of the United States Capitol buildings. More recently the disc type has been departed from, but in other respects the proportions of the Capitol fans have been followed, and have now become established in general practice. It was a recognised necessity that a fan should be reduced to its least practicable dimensions, and the most cursory observation showed that the passage of air through the fan itself was an accelerating flow, whose least velocity should be ,that at which the entering air approached the inner edges of the blades, and its greatest velocity should be that at which the escaping air left the tips of the blades; the action of the blades being to give an accelerating velocity, to be mainly derived from the increase of velocity of the blade surface as it became further from the centre. It followed as a resulting consequence that the area of any cross section of the passage through the fan (any one of which will be formed between the disc and wall or case side, and between any two blades) should reduce in proportion as the air accelerates, and that the air should thus be kept in contact with, and be acted upon by, the blades as the source of impulse. These propositions gave, for instance, where the disc of the fan was taken to have a diameter equal to one, the diameter of the mouth or central opening becomes seventy-four hundredths; the width of the fan at the mouth becomes seventeen-and-a-half hundredths; while the width at the periphery becomes one-tenth. The number of blades was found (by experiments as to most efficiency with several different numbers) to be about sixteen, a number giving the section of the several passages formed by blades, disc, and wall, most nearly a square one, or most nearly that section of a duct or passage where the sides offer the least resistance to flow of a fluid.

The advantages in effectiveness or economy in power over other fans as before made, with small central opening and great width of vanes in direction of the axis, is not very considerable; 10 to 15 per cent of higher useful effect

---

[*] A Paper presented to the American Society of Civil Engineers, January 26, 1881.

is all that can be claimed when 55 to 60 per cent is usual; but the advantage of obtaining at least twice the capacity simply by enlarging the mouth and by increasing the number of blades to suit their reduction in length, is of high importance when room to place a fan in a building is frequently one of the troublesome questions to be met. Since 1856 probably 150 of these fans have been put into use in various hospitals and public buildings. The principal modification adopted has been the frequent use of blades on both sides, with the same disc construction, sometimes (for fans of four to eight feet diameter) with iron in lieu of brickwork cases. This last arrangement presents some difficulties in the entering air passages, but it reduces the diameter of a fan to do any given work to seven-tenths that of a single disc fan.*

In general these fans are driven by a directly connected engine of suitable size: sometimes a belt and pulley is used for transmission from an independent engine. This condition, that of independence from other uses, is desirable for hall ventilation, so that an economy of working may be practised to meet the condition of occupied and unoccupied halls; but for hospital ventilation it is about as well to drive the fans from the general source of motive power always indispensable in large hospital establishments.

Boilers and their appliances, engines, &c., are not distinctive or peculiar to ventilating or heating apparatus, and call for no mention in this paper as to methods of construction.

The steam heating apparatus in all its details, as used in America, is peculiarly American, especially the apparatus of small wrought-iron tubes, which had its origin at the hands of the late Joseph Nason, between 1840 and 1850, and has now become one of the established industries of the land, employing a whole class of workmen known as steam-fitters, and supporting large establishments devoted entirely to the manufacture of and trade in tubes and fittings.

The little step in mechanism which is the foundation of this art is found in the use of the tapering thread on the end of the pipes, wherewith a perfectly staunch joint is cheaply provided and made. It is curious that with over forty years' practice in steam-fitting, until no workman in iron regards this taper screw joint as other than the matter-of-course way of making a pipe-joint, with this established habit of workmanship, no description or notice of the tapering screw is published in any text-book, nor have its peculiar advantages been considered by any general writer on constructive mechanism. The great importance of this improvement in making the joints of steam pipes to this industry of steam heating can scarcely be over-estimated; but it was not only in this particular, but in many others of detail, that Mr. Nason's ability as an inventor and adaptor was shown in the apparatus: while super-eminent above this, he was at once the best informed of his day on the theory, and the most able in the practice, of steam-heating. Under his tuition the whole trade originated—ten or twelve years since it was possible to trace the descent or pedigree of any concern in the business to the original source—at this time; the growth of the business going to a third or fourth race of firms or workmen precludes the following out of the continuity, although it certainly exists. The business, however, has been, and is, dependent upon the development of mechanical ingenuity, mainly from Joseph Nason, who gave form to the globe-valve, originated and derived or adapted from the practice of hot-water heating apparatus in England—either the Perkins's high pressure or the greenhouse low pressure system—all the essential details which now form parts of usual everyday construction in the United States. Curiously, steam-heating as practised here, is not yet fully known or used in England or France, and but little more known in Germany.

The writer of this paper became connected with Mr. Nason in 1848, when he was employed to superintend the construction of tube works at Malden, near Boston, for Messrs. Walworth and Nason, and from that time until now he feels able to claim some standing in advancing the industry of steam-heating. It will have been noticed by most who have to do with construction that the form and shape of valves, elbows, tees, and of details generally employed or made at any time in the country are strikingly similar. In fact they are universally copies, following exactly the designs and proportions, as to sizes and thicknesses, which the writer established and published in the catalogues of the Pascal Iron Works, nearly twenty years since.

From this general acceptance of the types of steam-heating apparatus and component parts anyone is at liberty to specify a definite construction of coils and mains with a correspondence of detail. He can measure and plan to use any arrangement of standard articles, selected from any trade catalogue of a steam heating establishment or firm, and feel sure that the work will have been so arranged that it can be bid for in open competition, and that he is getting the best work, or details of work, to effect his purpose in his own way. More than this, it may be regarded as tolerably sure that any patented improvement of detail or method is inferior to what can be procured and supplied from regular traders.

(To be continued.)

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, June 16, 1881.

Prof. H. E. Roscoe, President, in the Chair.

The following certificate was read for the first time.—F. Sear.

During the evening a ballot was held, and the following gentlemen were declared, by the Scrutators (Messrs. Groves and Warington) to be duly elected Fellows of the Society.—A. B. Avarne, G. H. Bostock, W. Bedford, B. Browning, J. M. Collett, A. W. Duncan, J. E. Doyle, A. E. Davies, H. Frankland, A. J. Hailes, C. W. Marsh, A. Philip, T. K. Rogers, J. Schwartz, O. Trigger, G. Tate, J. P. Wilkes.

The President read a letter which he had received from Lieut.-Col. Malcolm, Hon. Sec. of the Museum Sub-Committee of the British Association, 17, Blake Street, York. It is intended to illustrate, at the forthcoming meeting of the Association, as far as possible, the progress which has been made in the construction of instruments of scientific research during the past 50 years. With this view scientific men, societies, and manufacturers, are invited to exhibit instruments of the latest patterns, and tools used in their construction, together with the instruments used in 1831. The Exhibition will last only from August 31st to September 8th. The President, therefore, invited Fellows of the Society who could exhibit such apparatus to forward, as soon as possible, details of the apparatus and space required to the above address.

Mr. W. H. Perkin then communicated a paper "*On the Isomeric Acids obtained from Coumarin and the Ethers of Salicylic Aldehyd.*" Some years ago, the author showed (*Chem. Soc. Jour.*, 1877, i., 388), that by the action of acetic anhydride and sodium acetate on the hydride of methyl salicyl, an acid (methyl-orthoxy-phenyl-acrylic acid) was produced. By treating the hydride of

---

* The only full published account of this fan is to be found in the *Proceeding of the Institution of Civil Engineers*, 1869-70, but the publication in the catalogue of apparatus of the Pascal Iron Works, Class IV., 1863, and subsequently, gives essential particulars, and has perhaps much aided in the introduction of the fan. The catalogue was compiled by the writer of this paper.

salicyl in the same way coumarin was formed. Tiemann has since shown that this is preceded by the formation of coumaric acid, which has a constitution analogous to the above acid, but has an atom of hydrogen in place of methyl. Now coumarin when treated with alkalies gives a coumarate, which, however, splits up into coumarin when treated with acids; but if treated with methylic iodide, it produces a methylated acid of the same composition and, apparently, the same constitution as that obtained by the action of acetic anhydride on the hydride of methyl salicyl; its fusing-point is, however, nearly 100° lower than the acid from the hydride of methyl salicyl. It can be converted into it by the action of heat. The cause of this isomerism being unintelligible, the author has undertaken the present investigation for the purpose of examining the acids, their derivatives, and any homologues which might be formed from the other coumarins. The acid obtained from coumarin is called by the author the α-, the other β-methyl-orthoxy-phenyl-acrylic acid. The α acid was obtained in magnificent highly refracting crystals; it is changed into the β acid by heat and by violet or ultra-violet light. The two methylic ethers and the α- and β-ethyl acids were prepared and examined. Nascent hydrogen converts both acids into the same acid, dihydro-methyl-orthoxy-phenyl-acrylic acid. The actions of nitric acid and bromine were also studied and various derivatives obtained. Isomeric dibromides were obtained, and experiments made with the methylic ethers of the acids; the β-ether yielded 70 per cent of a dibromide, melting at 68·7°, and 30 per cent of a dibromide, melting at 125°; the α-ether yielded as a principle product a dibromide, fusing at 125° with a small quantity of the body melting at 68°. The action of bromine on the α- and β-ethylic ethers was also studied. The actions of fuming hydriodic and hypochlorous acids were examined. The derivatives from propionic and those from butyric coumarin were next prepared. These coumarins yielded acids analogous to that from ordinary coumarin. From the author's researches, it appears that in general, the effect of chemical action on the α acids, is to convert them into the same compounds as are yielded by the β acids under similar circumstances. This is probably due to the heat evolved by the chemical action converting the α into a β derivative. The limited action of bromine is an exception, but in this reaction but little heat is evolved. The hypothesis that the isomerism resulting from the difference of structure of this group is considered, but is not thought by the author to be established. The physical differences of the α- and β-ethers, described in the paper, are considered, and the author concludes that as the boiling-points, densities, refractive indices, &c., of the α compounds are all lower than those of the β body, and the α compounds are the less stable, it is probable that the molecules of the α body are further apart than those of the β body. Reference is made to the fact that the formation of these α bodies is always connected with dehydration and rehydration, and a suggestion is made that if a difference of proximity of the groups is the cause of the isomerism, it is probably due only to a difference of distance between the radical and the hydroxyl. It is also pointed out, that in most cases, where bodies are, what is called, physical isomerides, they are hydroxylised products.

Mr. Fletcher then gave a short statement of the results which he had obtained from the measurement of the various crystallised bodies prepared by Mr. Perkin.

Dr. Wright suggested that it would be interesting to determine the heat of combustion of one or more pairs of these α and β bodies.

Prof. Hartley thought that probably some difference might be found in the optical transparency of these isomeric bodies.

Dr. Armstrong then communicated a paper by Mr. G. Lowe and himself, entitled "*Notes on Naphthalene Derivatives.*" The authors have continued their investigations as to the action of sulphuric acid on naphthalene, and confirm their previous statement that three and not two disulphonic acids may be obtained. By operating at 180°, a mixture in about equal proportions of the α and β disulphonic acids of Ebert and Merz is obtained; but at 100° a third acid is also formed, corresponding to the dihydroxy-naphthalene melting at 156°, which they have described. This third acid is obtained in relatively small quantity, and the authors have not yet established the conditions which are most favourable to its production, nor have they devised a satisfactory method of separating it from the isomerides. They have confirmed their observations on the action of fused potassium hydroxide on potassium β-naphthol-sulphonate, but doubt whether more than a single body is produced in the reaction. It crystallises from hot water (in which it is much less soluble than the dihydroxy-naphthalene previously described) in small plates melting at 218° to 220°: it separates from acetic acid in large ammonium chloride-like forms. The alkaline solution exhibits a blue fluorescence, and rapidly darkens on exposure to air. Dr. Armstrong then described an isomeric β-naphthol-sulphonic acid obtained by Mr. Stallard and himself by dissolving β-naphthol in cold concentrated sulphuric acid. The authors were led to the discovery of this substance by noticing that when less sulphuric acid than Schaefer prescribes for the preparation of β-naphthol-sulphonic acid is used, it is difficult to obtain the salts in the clear transparent crystals so characteristic of the β-naphthol-sulphonates. The salts of the new acid are much more soluble, and when submitted to the action of bromine or nitric acid readily exchange the sulpho group for bromine or NO_2, forming bromo- and nitro-derivatives of naphthol. The acid previously known retains its sulpho-group under similar treatment. Dr. Armstrong demonstrated this reaction to the Society, and pointed out that it was a good lecture illustration of the extraordinary difference of the SO_3H group, according as it occupied the so-called α or β position in naphthalene.

Mr. G. S. Johnson then read a paper "*On the Synthesis of Ammonia* (*Third Notice*)." This paper is practically an answer to the criticism of Mr. L. Wright on the previous communication of the author. Mr. Wright stated that the nitrogen used by the author was not pure, and that it contained nitric oxide, and that the ammonia formed was due to the presence of this impurity. The author of the present paper points out that he relied for the purification of his nitrogen from nitric oxide not on an acid solution of ferrous sulphate, but on pumice impregnated with hydrated ferrous oxide precipitated by the ammonia evolved on boiling the ammonium nitrite. He has repeated his previous experiments, and tested the N carefully for NO by mixing with air and bubbling through starch and potassium iodide solution. Although no blue colour was seen in half an hour, yet this pure N when mixed with H still formed ammonia. Other experiments were made in which the nitrogen was purified by mixing with air and allowing the mixed gases to stand for some hours over water rendered alkaline with potash. This also produced ammonia when mixed with hydrogen and passed over spongy platinum. The author finds that when the pure nitrogen is passed through heated asbestos before mixing with hydrogen it is no longer capable of combining with hydrogen in the presence of spongy platinum. This experiment was exhibited to the Society. As long as the asbestos was hot no ammonia was produced, but on allowing it to cool, after about twenty minutes a Nessler solution became distinctly yellow. The author thinks that this experiment indicates the existence of an active allotropic nitrogen analogous to ozone, and hopes to produce further evidence on this subject. He concludes that he has proved that the synthesis of ammonia from hydrogen and nitrogen, obtained by the action of heat upon a solution of ammonium nitrite, is possible in the presence of spongy platinum.

Mr. J. Mond said that after two years' work at every conceivable means of causing the direct union of nitrogen and hydrogen with spongy platinum, platinised asbestos, &c., he had only met with negative results, and had come to the conclusion that the silent discharge was the only means of effecting the direct union of these two elements.

Mr. W. A. Shenstone then read a paper "*On the Alkaloids of Nux Vomica.*" The author has, with the aid of Messrs. Hopkin and Williams, extracted the alkaloids from 56 lbs. of the seeds of *Strychnos Nux vomica.* His object was to prepare and examine the alkaloids prepared by using as little heat as possible, and avoiding heat in the presence of acids or alkalies altogether. The process used is similar to that employed by Dr. C. R. A. Wright. A solution of sulphate of brucine was finally obtained, from which the alkaloid separated on exposure to ammonia vapour. The brucine was finally purified by conversion into hydriodide, regeneration with sodium carbonate, &c. The brucine obtained did not yield any evidence of the presence of strychnia, and gave a crystalline acetate. Many analyses of the product are given, which agree with the formula $C_{23}H_{26}N_2O_4$. About 20 ozs. of mixed crystalline alkaloids were obtained. The author searched the mother-liquors very carefully for the so-called isagurin, but all such bodies were proved to be brucine with a trace of some persistent impurity. By the action of alcoholic soda on brucine a hydro-brucine, $C_{23}H_{28}N_2O_5$, was obtained. Its colour reactions are distinct from those of brucine.

Prof. Hartley then read a short paper entitled "*Notes on Photographs of the Ultra-violet Emission Spectra of certain Elements.*" The author draws the following conclusions:—The ultra-violet spectra are comparatively free from air-lines. All the most important groupings of metallic lines appear in the ultra-violet region. The sharp clear cut appearance and the nebulous character of certain lines are even more strongly marked than in the visible spectrum. Not only are long and short lines noticeable, but many rays which consist of mere dots are characteristic of certain spectra, while certain strong lines appear to stretch not only across the spectrum, but above and below its boundary edge. When the photographs of the elements are arranged in Mendeleeff's series certain well-defined groups exhibit similarities in their spectra, *e.g.*, Mg, Zn, and Cd; Fe, Co, Ni: Al, In, Tl; Cu, Ag, Hg. Palladium also has a spectrum somewhat similar to the spectra of the iron group. Prof. Hartley exhibited some of the beautiful photographs on which the above statements are based.

Mr. S. U. Pickering gave a brief statement of the results arrived at in his paper "*On the Sulphates of Aluminium.*" He has examined the seven or eight sulphates of aluminium which are said to exist, but has in most cases not been able to find any evidence of their existence.

"*On Two New Oxides of Bismuth,*" by M. M. P. Muir. The author has repeated Boedeker's experiments on the action of aqueous potassium cyanide on a hot nitric acid solution of bismuth nitrate, but finds that the puce-coloured salt which is produced has the formula Bi_2O_7, and not $Bi_2O_5,2H_2O$, as assigned to it by Boedeker. The new bismuth heptoxide is a fairly stable compound towards heat: it begins to part with oxygen at about 200°; soluble in acids, giving deep red liquids, which are only very slowly decomposed and decolourised by boiling. A hot concentrated solution of caustic potash dissolves 25 per cent of the new oxide, forming a very deep red liquid, from which acids throw down a red-brown substance containing bismuth, oxygen, and much water, but, after washing with hot water, free from potassium. The portion insoluble in hot potash consists of another new oxide of bismuth. Bismutho-hypobismuthic oxide, Bi_4O_7, sp. gr. 8·5, reacted on by potash, dissolves in acids to purple-red liquids, only very slowly decomposed by boiling; does not lose oxygen till heated over a Bunsen lamp. Neither oxide takes up water from moist air.

The Society then adjourned over the summer recess.

NOTICES OF BOOKS.

The Law of Therapeutics, or the Science and Art of Medicine. By Joseph Kidd, M.D. Second edition. London: C. Kegan Paul.

"He is a truly scientific physician," says the author, is now often a by-word for contempt. There are, it must be admitted, medical practitioners without end who, contrary to the vulgar notion, are not in any sense "men of science." They reject all modern instruments and modes of research; they laugh at the use of the microscope and of chemical reagents in ascertaining the nature or the cause of disease. They have no good word to say for physiological investigation, and sometimes, in consequence, throw themselves into the arms of the anti-vivisectionists, who are not slow to parade them as "scientific" converts to the agitation. Such men, though making no advances in medical theory, are not unfrequently successful routine practitioners, guided by tact rather than by definite principles. Dr. Kidd aims at something the very opposite. He holds that "of all studies, that of Therapeutics, or the treatment of disease, ought to be the most accurate." Where human life is at stake it saddens him to think how much still depends upon chance. What man accustomed to exact scientific work does not share this feeling? In his historical survey of therapeutic laws, or rather the gropings after such, many interesting facts are brought into view. It is shown that hospitals were not, as Dr. Farrar assumes, unknown to the civilisation of antiquity. The dispensary of the ancient Egyptians and the "Asclepias" of the Greeks contained the germ of the modern hospital. Perhaps the canonisation of personal dirtiness and the abolition of the Roman baths, effected in obedience to the dictates of Oriental asceticism, made the need and the scope for hospitals all the greater.

Of Haller, the author speaks, in our opinion, much too highly. There must have been something sadly wrong in the mind of the man who could "damn himself to everlasting fame" by such an utterance as his "*nulla est epigenesis!*"

Of Hahnemann and his system, the author takes a discriminating view. He admits the so-called fundamental homœopathic principle, "*similia similibus curantur,*" as an important therapeutic law, though not indeed to the exclusion of the antipathic law of Galen, *contraria contrariis curantur.* But the developments of homœopathy, the infinitesimal doses, and the idea of "potentiation" or dynamisation, Dr. Kidd treats with the contempt which they experience and deserve from men of scientific habits of thought. He appeals from Hahnemann drunk with mysticism to Hahnemann sober, and he considers that medical practice generally has been modified for the better by the promulgation of homœopathy.

A passage concerning the researches of Dr. Brown-Séquard should not be overlooked in the present fanatical temper of a large part of the British public:—"When Brown-Séquard, the distinguished man of science, settled down to practise medicine in Cavendish Square and at the National Hospital for the Paralysed and Epileptic, he quickly showed that the most minute and delicate experiments upon animals were to throw a flood of light upon the medicinal treatment of the diseases of man. Many epileptic and paralysed patients have had cause to bless the labours of the man who for so many years patiently experimented upon guinea-pigs and rabbits in the causation of epilepsy and paralysis."

"It is fashionable," says the author, "now-a-days for every clever writer to explain that disease is not an entity or a substance." Yet, as he adds, the poisons of cholera, typhoid, and doubtless other diseases are very positive entities from without. Of "expectant treatment," he writes that "Hospital physicians, accustomed chiefly to recent cases of disease, mostly of sub-acute nature, find good feeding, nursing, plenty of fresh air, and perfect rest, do so much for their patients—often moved from homes devoid of any hygienic attribute to the large airy wards of the hospital—that they are apt to lose faith in medicine. To them it is much to abstain from the routine of evil drugging. The contrast of their results is so decidedly favourable in comparison with the bleeding, leeching, and blistering of an age not quite gone by; but away from the hospital, among varied and perplexing chronic diseases the fashion of scepticism with regard to drugs avails but little."

Dr. Kidd recognises the "*vis medicatrix naturæ*," but it seems that he overlooks that counter-agency which the late G. H. Lewes well named the *vis deletrix*.

The author's remarks on food are highly judicious. He is not an adherent of any of the modern fanaticisms, such as teetotalism, or that pseudo-vegetarianism which rejects beef and mutton, whilst tolerating milk, cheese, and eggs. Yet he is no friend of the indiscriminate use of alcoholic stimulants, and he believes in milk to an extent scarcely justifiable in times when so many cows are known to be affected with tubercular disease. He complains that the "doctor is beset by a multitude of infant's foods. These evils—for evils they are—and quack medicines as well, would soon disappear if the law of libel were cut down to reasonable limits, so that they might be safely criticised.

We regret our inability to devote more scope to Dr. Kidd's volume, and we trust that its teachings will be fully appreciated by the profession.

Tin, a Geological-Mining-Historical Monograph. (Zinn, eine Geologisch-Montanistische-Historische Monografie.) By E. Reyer. Berlin: G. Reimer.

The author of this useful compilation divides his subject geographically. He treats, first, of the geology of the Saxon and Bohemian tin regions, and gives a history of tin mining at Graupen, Altenberg, Zinnwald, Platten, Erenfriedersdorf, Geier, and Schlackenwald. It appears that the tin-deposits were discovered and utilised as early as the 12th century. In the 15th century the produce of the Saxon and Bohemian tin mines was greater than that of Cornwall, but it has since fallen into comparative insignificance. Most of the mines have been abandoned in the present century, and in 1850 the entire yield of the Erzgebirge was only 2500 cwts. Since that time it has not increased.

Passing over to England, the author describes the geology and the mining industry of Cornwall and Devon. There is appended a glossary of the peculiar Cornish technical terms for rocks and minerals—a language not much more intelligible to the ordinary Englishman than to the foreigner, and which on the "*omne ignotum pro magnifico*" principle, greatly aids promoters of mining companies in mystifying the public, since it is brought into use in every part of the world where Cornish mining engineers are sent.

The tin deposits of Spain, Portugal, France (Bretagne), Italy, Finland, Sweden, Greenland, and Siberia are also noticed.

Of more importance are the tin mines of south-eastern Asia. Not merely the Malay peninsula and the islands of Banka and Bilitong, but the entire eastern coast of the Bay of Bengal, Java, Sumatra, the western coast of Borneo contain deposits of this metal. The Banka tin works are no longer so productive as in the years 1855-59, but the average yield is still about 4400 tons.

The total Australian production for the year 1877 is given as 13,000 tons. As regards the future of Australian tin mining the author takes a judicious view intermediate between the pessimist accounts of Cornish mine owners, anxious for high prices, and the exaggerated views of the Australians.

The North American production of tin is insignificant. Peru, Bolivia, and Chili yield small quantities, but the Peruvian tin is contaminated with tungsten, arsenic, and antimony, and is consequently not in request.

The remainder of the book is devoted to an account of the probable origin of tin ores, and of the smelting processes adopted in the different districts. The applications of tin are briefly noticed, its uses in the art of dyeing being dismissed in a few lines. Various processes for the recovery of tin from tinners' waste, clippings, &c., are noticed. The work is enriched with a very complete bibliography of the subject.

The following consideration with which the author concludes may throw a light on the general average of profit which may possibly be expected from mining. During the last 500 years in the mere process of separating the tin ore from sand, &c., 1,462,000 masses of earth and stone, ten metres high by the same measurement in length and width have been worked through, sifted, and washed! If we consider that it takes a man, on an average, a day to work through a ton of detritus, we have three milliard days' works spent in this one department of tin winning!

Education, Scientific and Technical; or How the Inductive Sciences are Taught and How they Ought to be Taught. By Robert Galloway, M.R.I.A., F.C.S. London: Trübner and Co.

The subject of this book is, as the author admits, inadequately expressed by the title. Its object, whether successful or not, is one with which we most ardently sympathise: Prof. Galloway trusts "his work will assist in arresting the competitive examination system, at least in the Science Schools carried on by the Department of Science and Art, and by the City Guilds; a system which, with the exception of England, only retrograde nations, like China, adopt; and that it will aid in causing us to follow in our educational systems the examples set by enlightened nations like Germany."

This declaration gives the key-note of the entire work. The author sets out with the admission, now no longer suppressed, that we are far behind most of the Continental nations in scientific and technical education. The two commonly alleged reasons for this inferiority, viz., our later entrance into the field, and the lack of the necessary funds, he shows to be insufficient. As far back as 1787, the Society of Arts was alive to the importance of the question. Nor are the resources deficient. If we sum up the revenues of the universities and the endowed secondary schools, the sums voted by Parliament, or contributed by private munificence, for the promotion of higher education, the amount would be startling, and would, *if rightly applied*, secure for us, as the author says, "the best general, scientific, professional, and technical education of any country."

The question may next be raised whether we lag behind from any natural deficiency of the British and Irish mind? The author, in addition to other evidence which might have been found, brings forward German testimony to the contrary. Prof. Max Müller, who has had ample opportunities of observing, declares: "The intellectual fibre, I know, is not different in the youth of England and the youth of Germany."

The first cause of our short-comings may be found in that inbred dislike of organisation, which is perhaps our greatest national weakness. As Dr. Wiese declares, "an extraordinary amount of power, time, and money is still wasted from a want of plan and unity."

A second cause of our deficiency is our system of teaching, which is made to turn almost entirely upon honours and examinations. Some years ago we had a great outcry about "university reform." It was contended that the exclusive attention paid at Oxford and Cambridge to classics and mathematics was a mistake. The reformers were partly in the right. "Of observation, experiment, induction, analogy, the mathematician knows nothing." In a very similar manner the attention of the classicist finds his attention withdrawn from things and fixed upon words only. He never learns, or rather, he unlearns, to observe forms, textures, colours, odours, grades of pressure, &c., or to note their differences and their likenesses. Instead of what *is* he cares merely what somebody has said about it. It is very significant, as the author quotes from Prof. Cooke, of Harvard University, that when the claims of scientific culture were first urged upon Oxford and Cambridge, they were opposed on the ground *that the experimental sciences could not be made subjects of competitive examination.* It is by no means clear to us that even Prof. Cooke feels the full absurdity of this argument. For what does it imply? Nothing less than a complete inversion of means and end. For even "eminent English scholars"—as distinguished from men of science—must admit that if the object of education is simply to pass an examination better than someone else, it is a mere waste of time. Unfortunately our sages have got over this difficulty. It was once remarked that if the ancient scholastics could have got hold of Newton's *Principia*, they would simply have erected a mountain of verbal disputations upon it. In a very similar manner our masters, tutors, and the like, having admitted the natural sciences in some sort into their colleges and schools, have simply made them also into a subject for examination papers. A reformation in the subjects taught is of very little moment without we amend the way of teaching.

In Germany "the principle of competition is almost entirely excluded as tending to foster a servile view of education, and to lead to spasmodic and exhausting efforts and feverish excitement rather than the healthy and harmonious development of the mental powers. The students' powers are carefully husbanded for employment in the serious toils of mature intellectual life: in England they are wasted in a ruinous and unmeaning rivalry of striplings." Instead of teaching a man how to *do* a thing we cram him to pass an examination in it.

Now there is scarcely a man whose opinion is worth the smallest scrap of paper upon which it could be written but condemns, more or less openly, our examinational system. Still it survives, and there is no immediate sign of its breaking up. The school master who should rise to a higher idea of education would simply lose his pupils. Where to make a beginning is the difficulty. If we had sufficient influence we should exhort all who have the disposal of appointments in their hands to announce "no examinees need apply."

The author's remarks on teaching chemistry are exceedingly valuable. He complains that our elementary chemical treatises, numerous as they are, are not simplified, but merely diluted. He considers that chemistry, as long as taught by the present methods, will never prove of any value to those who study it as a branch of general education (*i.e.*, to nine students out of every ten), but only to those who study it as a profession, and even the latter might become sooner and better acquainted with it than at present. The author's own system appears to have proved successful both at schools of a lower grade and at the Museum of Irish Industry.

In concluding this brief notice we will merely wish this book an extended circulation, and its ideas a still wider appreciation. It is a manly and an enlightened attempt to declare, as does Prof. Galloway, war against an increasing evil, the real nature and magnitude of which few have realised.

Illusions, a Psychological Study. By James Sully. London: C. Kegan Paul and Co.

The object of the author in the present volume is to "take a wide survey of the field of error," including not merely the ordinary illusions of the senses, but other errors, similar in their mode of origin. Although the work is avowedly addressed in chief to psychologists it is not without profound interest for the student of physical science, who has carefully to avoid finding his own hypotheses and expectations in the phenomena which he is observing. Mr. Sully makes the happy remark that:—"Our luminous circle of rational perception is surrounded by a misty penumbra of illusion." He distinguishes illusion from hallucination thus: The former is a mere partial and the latter a total displacement of external fact by a fiction of the imagination, but he admits that the line is narrow. He distinguishes illusions according to the kinds of knowledge which they simulate, *i.e.*, those of perception, of introspection, of insight, of memory, and of belief.

In the section on the illusions of perception, which will have for the majority of our readers the greatest importance, we particularly notice the author's discussion of the effects of expectation. He distinguishes here *sub-expectation* and *vivid expectation.* In the former state, though not distinctly anticipating any one kind of object, we think that something will happen or be seen. Any emotion throws the mind more or less into this state. A feeling of awe makes us ready to perceive whatsoever is strange, mysterious, or apparently supernatural. In vivid expectation some one thing is looked for, and, in consequence, it is supposed to be seen, heard, or felt. A characteristic instance is here quoted which may be true:—"An officer, who superintended the exhuming of a coffin, rendered necessary through a suspicion of a crime, declared that he already experienced the odour of decomposition, though it was afterwards found that the coffin was empty." Of a like origin is the evil odour which so many persons at once experience if they learn that a chemical manufactory, or especially sewage-works, exist anywhere in the neighbourhood. We have heard of an establishment of the latter kind having been complained of as an actual—not prospective—nuisance, when it merely existed as a plan in the engineer's office! How widely perception of another nature may be vitiated by expectation is shown in an incident which happened when Davy first exhibited the properties of potassium to his contemporaries. A gentleman of some scientific merit, lifting up a portion of the new substance, exclaimed, "Yes, it is certainly metallic, and very ponderous"! Such facts may well impress upon young chemists and physicists the necessity of great caution when investigating a new subject. It is a wise precaution in all cases where expectation may be the father to perception to submit the phenomenon to the view of some acquaintance who is expecting nothing. But we have eminent, or at least noisy men, who, lest they should see or hear what is non-existent, fall into the counter-illusion, and do not see phenomena really in their presence.

We regret that want of space does not allow us to extend any further our survey of this important work, which we can recommend as a masterly exposition of its subject.

Annual Report of the Director of the Mint to the Secretary of the Treasury for the Fiscal Year ended June 3, 1880. Washington: Government Printing Office.

This report is in its nature fiscal and statistical, and does not furnish any novel information on refining and assaying.

An Elementary Course of Practical Physics. By A. M. Worthington, M.A. London: Rivingtons.

The author's object in this work is to propose a course of physical instruction, calculated to afford a good training in skilful manipulation, exact observation, intelligent and orderly recording of phenomena observed, the intelligent application of arithmetic, geometry, algebra, and the varying of experimental conditions. He enumerates the articles required for his course, and shows that to fit a school laboratory for really useful work does not involve any really formidable outlay. He deprecates "cram," as does every man whose opinion is worth the scrap of paper upon which it can be written. But cram still goes on increasing, and will increase till the educational world has its Cromwell with the will and the power to do away with competitive examination in its every form. We are not disposed to differ from Mr. Worthington in his high estimate of the value of physics as an agent for the cultivation of the intellect. The author's rules to be observed by boys working in the laboratory are very judicious.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences. No. 20, May 16, 1881.

Transformation of Morphine into Codeine and Homologous Bases.—M. E. Grimaux.—Codeine is a methylic ether of morphine, and from the latter may be obtained a series of new bases, of which codeine is the type and morphine the substratum. The author gives these compounds the generic name of codeines. Codeine is codo-methyline, and a base, which the author has discovered, $C_{19}H_{23}NO_3$, is codethyline.

Principle of the Conservation of Electricity.—M. G. Lippmann.—The principle of the conservation of electricity is expressed by the condition of integrability (α). It is susceptible of new applications, and permits us, not merely to analyse certain phenomena, but to deduce from the them existence and the law of new phenomena, which experiment has not yet detected. As the first example, he shows that what may be called the coefficient of electric contraction of a gas is equal to its refractive power for light. The author applies the same analysis to various electric phenomena, such as the expansion of the glass of a Leyden jar during charging; electrisation by the compression of hemihedral crystals; the pyro-electricity of crystals. Among other results are the existence of the following phenomena not yet verified by experiment:—(1) The dielectric power of glass augments under the action of mechanical traction; (2) non-superposable hemihedric crystals change their form when submitted to electric influence, and this deformation is sometimes opposite in direction to that which electric attractions tend to produce; (3) a pyro-electric crystal becomes heated or cooled on the approach of an electrised body, according as such body is in a positive or negative state. The phenomena thus foreseen are the inverse of the phenomena from which they are deduced. To establish their existence, the equation (α) is each time necessary; the principle of the conservation of energy taken alone does not suffice.

Theory of Rotatory Polarisation.—M. En. Mallard.—A mathematical paper, not adapted for abstraction.

Graphic Method of Representing the Phenomena brought into Play in Dynamo-electric Machines.—M. Deprez.—The author has found a graphic procedure of great simplicity, which enables him to calculate directly the value of the current produced by a dynamo-electric machine in all possible conditions of the speed of the ring and the resistance of the outer circuit. This process is based on the construction of an experimental curve which varies in each machine, and which the author calls the "characteristic" of the machine. To construct it, every communication between the ring and the electro-magnets' excitors is suppressed, and the current of known strength is turned into the latter; an arbitrary speed of rotation is then given to the ring, which is the same in all the experiments. We measure then by any known method, the difference of potential which exists between the two extremities of the induced circuit, which is broken. If we vary the intensity of the auxiliary current thrown round the electro-magnets, the difference of potential of the extremities of the induced circuit will undergo corresponding variations, and on taking the intensities of the auxiliary current as the abscissæ of a curve, and the differences of potential of the extremities of the induced circuit as ordinates, the characteristic curve is obtained.

Hydrates Formed by Chloride of Calcium.—M. H. Lescœur.—The author considers that the existence of hydrates, containing respectively 1, 2, 4, and 6 mols. of water may be admitted.

Solubility of Mercurous Chloride in Hydrochloric Acid.—MM. F. Ruyssen and E. Varenne.—The solubility of mercurous chloride, unlike that of silver chloride, is greatly dependent upon time of contact.

Non-Existence of Microzyma Cretæ.—MM. Chamberland and Roux.—The authors controvert, experimentally, the presence of a supposed ferment in chalk as assumed by M. Béchamp, in 1866.

Crystallisation of Alums.—M. A. Loir.—The various faces of a crystal have not all the same power of attraction for a body contained in the solution employed to feed the crystal.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin. Vol. 13, No. 11.

Simple Method of Determining the Temporary Hardness of Water.—V. Wartha.—In order to ascertain the alkalinity of springs on the spot, with samples not exceeding 10 c.c., and with a single reagent, the author makes use of a tube of 30 to 40 c.m. long, closed at the bottom, and with a mark showing the capacity of 10 c.c. From this mark upwards the tube is graduated into 0·1 c.c. To determine the temporary hardness the tube is filled to the lowest mark with the water in question, and a little piece of filter-paper, which has been previously steeped in extract of logwood and dried, is thrown in, thus giving the water a violet colour. Centinormal hydrochloric acid is then added from a dropping bottle, till the colour of the liquid inclines to an orange. The tube is then closed with the thumb and well shaken. The greater part of the carbonic acid escapes, and the liquid becomes red again. Acid is again added, and the shaking repeated until the next drop of the acid turns the liquid to a pure lemon-yellow, a point which a little practice is easily reached. The amount of acid used is read off on the tube itself. The author proposes to express the alkalinity of a water by the number of c.c. of centinormal acid needed to neutralise 10 c.c. He thinks that this method will be found useful both for sanitary and geological purposes.

Chemistry of the Platinum Metals.—Theodor Wilm.—Contrary to the prevalent view, all the platinum metals, if precipitated by zinc in a state of very fine division, are soluble to a considerable extent in nitric acid, whether weak or strong, so that palladium cannot be separated from such a mixture by means of nitric acid. The solubility appears to depend on the relative proportion of one or other of the metals in the mixture (mass action). Pure palladium, even in thin leaves, is not easily soluble in nitric acid, whilst all the other platinum metals are perfectly insoluble if in a moderately compact condition. Palladium cannot be isolated by agitation with mercury from a solution which along with the platinum metals contains base metals, such as copper, lead, &c., since the mercury precipitates, not merely the palladium, but all the other platinum metals, forming probably amalgams. From the platinum metals thus precipitated by mercury, metal free from mercury cannot be obtained by distillation and subsequent ignition, since a part of the mercury forms a stable compound with the platinoids.

Action of Bromine upon Toluol and Certain of its Derivatives.—C. Loring Jackson and A. W. Field.—This paper was read before the American Academy of Science on June 12, 1878.

An Explosion Furnace.—L. von Babo.—This memoir cannot be reproduced without the two accompanying illustrations.

MISCELLANEOUS.

An Industrial and Technological Museum.—An Industrial and Technological Museum of a very comprehensive character is in course of organisation at Sydney. It is to include animal, vegetable, and mineral produce in the crude and in the manufactured states; waste products, of whatsoever origin; foods with their constituents, and that necessary shadow side of the picture, their adulterations; educational appliances; sanitary apparatus and systems, models, plans, machinery, &c., for mining; agricultural machinery and manures; models, drawings, and descriptions of patents; a department of economic entomology; ethnological specimens, &c. One remark in the prospectus may call up a smile. The museum is intended to occupy a similar position to the South Kensington Museum. This might be construed to mean that it is to occupy a site as far out of the way of merchants, manufacturers, patentees, &c., as possible. We need scarcely say that the project has our best wishes.

Glycerin.—Notwithstanding the low price which now prevails for almost every description of raw produce and manufactured goods, there are a few articles which form notable exceptions. Perhaps one of the most remarkable of these is refined glycerin, which, within the last two years, has advanced from about £30 to £130 per ton avoirdupois for 30° B. This enormous advance is due partly to increased consumption, diminished production, and the influence of speculation working on a market devoid of stocks. In view of the present position of the article and the prospect of a continuance of high prices for a considerable time to come, the attention of soapmakers is now being turned to the utilisation of their waste "leys," and various new processes for recovering the glycerin contained in these liquors have lately been been tried with more or less successful results. Apart from minor impurities, waste soap "leys" are generally found to contain glycerin, carbonate of soda or caustic soda, chloride of sodium, gelatin, and albumen. One of the processes for recovering the glycerin which promises to be the most economical and the most successful begins with concentrating the liquor until the salts contained therein begin to crystallise. The liquid is then cooled and filtered to rid it of gelatin and albumen. It is afterwards made to absorb carbonic acid, which precipitates bicarbonate of soda, and which is separated from the liquor in the usual way. After undergoing this process the liquor is then made to absorb gaseous hydrochloric acid until what remains of carbonate of soda has been converted into chloride, and further, until all, or almost all, the chloride of sodium has been precipitated and separated from the liquor in the usual manner. Arrived at this stage, the liquor contains water, glycerin, and hydrochloric acid. The acid is then evaporated entirely and absorbed in water for using afresh. The dilute glycerin remaining can be purified by filtering it through animal charcoal or by concentrating and distilling it in the usual way.—*Glasgow Herald.*

MEETINGS FOR THE WEEK.

Monday, 27th.—Royal Geographical, 8.30.
—— Society of Public Analysts, 8. "On the Estimation of Quinine in Wines, Tinctures, &c.," and "On the Figures or Patterns which Drops of Various Fats Assume under Certain Conditions," A. Wynter Blyth, M.R.C.S. "On a Modification of Wynter Blyth's Apparatus for Digestions in Ethers as Applied to Milk Analysis;" and "On a New Burner for Griffin's Gas Muffle Furnace," W. F. K. Stock, F.C.S., F.I.C. "Some Remarks on the Swedish Laws and the Quantity of Arsenic really Prohibited," C. Heisch, F.C.S., F.I.C. In reference to the Swedish laws for the sale of Poisons, Dr. Wallace will exhibit a certificate of a test for arsenic in a carpet, by the Government Chemist at Stockholm, with tube containing the result of the test and a piece of the carpet.
Wednesday, 29th.—Society of Arts (Anniversary), 4.

TO CORRESPONDENTS.

A Correspondent.—We learn that the margarimeter can be obtained at 16, Rue Sauval, Paris.

IRISH HILL BAUXITE (Alum Clay).

THE **IRISH HILL MINING CO.** are now, and always have been, the LARGEST PRODUCERS OF THIS CLAY, of Superior Quality, and supply the Manufacturers of Alum, Sulphate of Alumina, and Alum-Cake, of the United Kingdom, America, and the Continent, almost exclusively.

ANALYSIS BY JOHN PATTINSON, ESQ.

	Dried at 212° F.		
	Gertrude (extra qual.)	1st Quality.	2nd Quality.
Alumina	59·00	53·83	52·00
Peroxide of Iron	0·47	1·57	4·57
Silica	18·00	8·67	12·00
Titanic Acid		5·80	6·20
Lime, Magnesia, Potash, Soda, and Sulphuric Acid	0·23	0·83	1·14
Combined Water	22·30	29·27	24·00
	100·00	99·97	99·91

Our MINES, DRYING KILNS, and GRINDING MILLS are situated very close to the Shipping Ports of BELFAST and LARNE, and adjacent to Railways running alongside both Steamers and Sailing Vessels at both Ports, from either of which shipping is abundant and cheap, therefore we can guarantee Regular Delivery as Buyers require it, and are prepared to quote prices f.o.b. c.i.f., or delivered at any Port, in Bulk or Bags, Lump or Ground.

GEO. G. BLACKWELL, *Managing Director.*

Richmond Buildings, 26, Chapel St.,
Liverpool.

ESTABLISHED 1798.

ROBERT DAGLISH & CO.,
ENGINEERS, BOILER AND BRIDGE MAKERS, MILLWRIGHTS,
BRASS AND IRON FOUNDERS.

Manufacturers of every description of Condensing, or High-pressure Blowing, Pumping, Rolling, Winding, and Patent Steam-engines, of any required power, for Irrigating, Draining, Mining, Rolling Mills, or Water Works purposes, and Manufacturers of every description of Chemical, Colliery, Copper Ore, Gold Mining, Glass, and Rock-salt Machinery.

Black-ash Revolving Furnaces of the Most Approved Type.

Bessemer Steel-Rail Plant.

Compressing-Engines for Collieries, Iron Works, and Weldon's Patent Bleaching-Powder Process.

Caustic, Chlorate, Decomposing, Nitre Nitro-Glycerine, Iodine Potash, Sulphur, Acid, and Oxalic Pans.

Gas Producers Patent for Heating and other Purposes.

Pyrites Burners for Irish, Norwegian, and Spanish Ores of Improved Construction.

Patent Rousing Machinery for Brewers.

Retorts, Acid, Gas, Iodine, Nitric, Nitre Nitro-Glycerine and Vitriol Refining.

Steam Superheaters improved for Oil, Tar, and Resin Refining.

Steam Sulphur Melter.

Stills for Oil, Resin, and Tar.

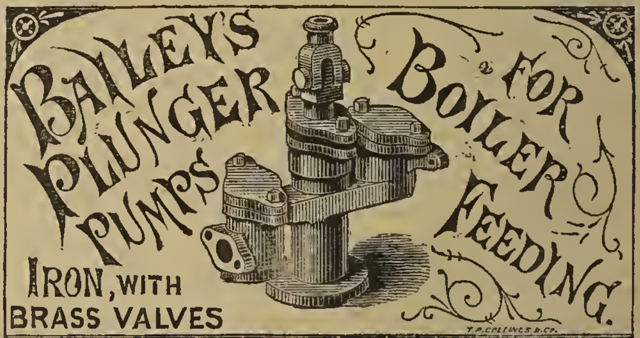
Wheels, Bevel, Mitre, and Spur Moulded on the Shortest Notice by Patent Machinery.

Makers of Mactear's Patent Carbonating Furnace, Jones and Walsh's Patent Sulphate of Soda Furnace, Parnell and Simpson's Patent Causticiser, and Kynaston's Patent Alum Plan

Lists sent on Application.

Photographs, Plans, and other information supplied on receipt of Order.

ST. HELEN'S ENGINE, BOILER, AND BRIDGE WORKS
AND FOUNDRY,
LANCASHIRE.



DIAM OF RAM INS	1¼	1½	1¾	2	2¼	2½	3	3½	4
PRICE	24/6	37/6	45/-	50/-	55/-	63/-	78/-	90/-	127/-
IF WITH GUN-METAL PLUNCER	40/-	55/-	70/-	90/-	110/-	150/-	200/-	250/-	300/-

BAILEY'S WATER MOTORS.

BAILEY'S HYDRAULIC LIFTS.

BAILEY'S INJECTORS.

Albion Works, Salford, Manchester.

ROYAL POLYTECHNIC.—Lurline, the Rhine Maiden, by Mr. George Buckland.—Arctic Exploration, by Commander Cheyne, R.N.—Porcelain Manufacture, by Mr. J. D. Cogan.—The Photographer's Sunbeam, by Mr. T. C. Hepworth.—The Rising in the Transvaal, by Mr. W. R. May.—Etherdo, the Juggler.—The Microscope, Electricity, the Isle of Wight, &c., by Mr. J. L. King.—Fleuss's Diving Apparatus.—The Electric Railway.—Balmain's Luminous Paint Room.—Recitals by Mrs. Stirling and others, at 3 on Saturdays. Admission to the whole, 1s. Open from 12 till 5 and 7 till 10.

INDEX.

END OF VOLUME XLIII.